



Dolby[®] Professional Reference Monitor Manual

Issue 1

Part Number 9112220

Model PRM-4220

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[SEE APPENDIX E](#)

Regulatory Notices

FCC

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with this instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

Canada

Cet appareil numerique de la classe A est conforme a la norme NMB-003 du Canada.


EU/EMC

This equipment complies with the Electromagnetic Compatibility (EMC) Directive requirement of EN55103-1:2009 and EN55103-2:2009 when operated in accordance with this manual.

WARNING: This is a class A product. In a domestic environment this product may cause radio interference, in which case the user may be required to take adequate measures.

Important Safety Instructions

1. Read these instructions.
2. Keep these instructions.
3. Heed all warnings.
4. Follow all instructions.
5. Do not use this apparatus near water.
6. WARNING: To reduce the risk of fire or electric shock, do not expose this apparatus to rain or moisture.
7. Clean the metal frame and chassis only with a dry cloth. Clean the screen only with an LCD compliant cleaning solution and a soft cloth.
8. Do not install near any heat sources such as radiators, heat registers, stoves, or other apparatus (including amplifiers) that produce heat.
9. No naked flame sources, such as lighted candles, should be placed on the apparatus.
10. Protect the power cord from being walked on or pinched, particularly at plugs, convenience receptacles, and the point where they exit from the apparatus.
11. Only use attachments/accessories specified by the manufacturer.
12. Unplug this apparatus during lightning storms or when unused for long periods of time.
13. Refer all servicing to qualified service personnel. Servicing is required when the apparatus has been damaged in any way, such as the power supply cord or plug is damaged, liquid has been spilled or objects have fallen into the apparatus, or the apparatus has been exposed to rain or moisture, does not operate normally, or has been dropped.
14. Do not expose the apparatus to dripping or splashing; no objects filled with liquids, such as vases, shall be placed on the apparatus.

15. CAUTION: Troubleshooting must be performed by a trained technician. To reduce the risk of electric shock, do not attempt to service this equipment unless you are qualified to do so.
16. Do not defeat the safety purpose of the polarized or grounding-type plug. A polarized plug has two blades with one wider than the other. A grounding-type plug has two blades and a third grounding prong. The wide blade or the third prong is provided for your safety. If the provided plug does not fit into your outlet, consult an electrician for replacement of the obsolete outlet.
17. This apparatus must be earthed (grounded) by connecting to a correctly wired and earthed power outlet.
18. Ensure that your mains supply is in the correct range for the input power requirement of the unit.
19. Ensure that any ventilation slots in the unit are not blocked or covered.
20. The mains power disconnect device for this unit is the plug-in mains cord rather than the power switch. The mains cord must remain readily accessible for disconnecting mains power.
21. To avoid exposure to dangerous voltages and to avoid damage to the unit, do not connect the rear-panel Ethernet port to telephone circuits.
22. As the colors of the cores in the mains lead may not correspond with the colored markings identifying the terminals in your plug, proceed as follows:
 - The green and yellow core must be connected to the terminal in the plug identified by the letter E, or by the earth symbol , or colored green, or green and yellow.
 - The blue core must be connected to the terminal marked with the letter N or colored black.
 - The brown core must be connected to the terminal marked with the letter L or colored red.
23. This apparatus must be earthed.



CAUTION – Danger of explosion if battery is incorrectly replaced. Replace only with the same or equivalent type. Dispose of used batteries according to local law.

PRODUCT END-OF-LIFE INFORMATION



This product was designed and built by Dolby Laboratories to provide many years of service, and is backed by our commitment to provide high-quality support. When it eventually reaches the end of its serviceable life, it should be disposed of in accordance with local or national legislation. For current information, please visit www.dolby.com/environment.



This symbol that appears on the unit rear panel is intended to alert the user to the presence of uninsulated “dangerous” voltage within the product’s enclosure that may be of sufficient magnitude to constitute a risk of electric shock to persons.



This symbol is intended to alert the user to the presence of important safety operating and maintenance instructions.

IMPORTANT SAFETY NOTICE

This unit complies with safety standard EN60065 as appropriate. The unit shall not be exposed to dripping or splashing and no objects filled with liquids, such as coffee cups, shall be placed on the equipment. To ensure safe operation and to guard against potential shock hazard or risk of fire, the following must be observed:

GB

- o Ensure that your mains supply is in the correct range for the input power requirement of the unit.
- o Ensure fuses fitted are the correct rating and type as marked on the unit.
- o The unit must be earthed by connecting to a correctly wired and earthed power outlet.
- o The power cord supplied with this unit must be wired as follows:
Live—Brown Neutral—Blue Earth—Green/Yellow

IMPORTANT – NOTE DE SECURITE

Ce matériel est conforme à la norme EN60065. Ne pas exposer cet appareil aux éclaboussures ou aux gouttes de liquide. Ne pas poser d'objets remplis de liquide, tels que des tasses de café, sur l'appareil. Pour vous assurer d'un fonctionnement sans danger et de prévenir tout choc électrique ou tout risque d'incendie, veuillez à observer les recommandations suivantes.

F

- o Le selecteur de tension doit être placé sur la valeur correspondante à votre alimentation réseau.
- o Les fusibles doivent correspondre à la valeur indiquée sur le matériel.
- o Le matériel doit être correctement relié à la terre.
- o Le cordon secteur livré avec le matériel doit être câblé de la manière suivante:
Phase—Brun Neutre—Bleu Terre—Vert/Jaune

WICHTIGER SICHERHEITSHINWEIS

Dieses Gerät entspricht der Sicherheitsnorm EN60065. Das Gerät darf nicht mit Flüssigkeiten (Spritzwasser usw.) in Berührung kommen; stellen Sie keine Gefäße, z.B. Kaffeetassen, auf das Gerät. Für das sichere Funktionieren des Gerätes und zur Unfallverhütung (elektrischer Schlag, Feuer) sind die folgenden Regeln unbedingt einzuhalten:

D

- o Der Spannungswähler muß auf Ihre Netzspannung eingestellt sein.
- o Die Sicherungen müssen in Typ und Stromwert mit den Angaben auf dem Gerät übereinstimmen.
- o Die Erdung des Gerätes muß über eine geerdete Steckdose gewährleistet sein.
- o Das mitgelieferte Netzkabel muß wie folgt verdrahtet werden:
Phase—Braun Nulleiter—Blau Erde—Grün/Gelb

NORME DI SICUREZZA – IMPORTANTE

Questa apparecchiatura è stata costruita in accordo alle norme di sicurezza EN60065. Il prodotto non deve essere sottoposto a schizzi, spruzzi e gocciolamenti, e nessun tipo di oggetto riempito con liquidi, come ad esempio tazze di caffè, deve essere appoggiato sul dispositivo. Per una perfetta sicurezza ed al fine di evitare eventuali rischi di scossa elettrica o d'incendio vanno osservate le seguenti misure di sicurezza:

I

- o Assicurarsi che il selettore di cambio tensione sia posizionato sul valore corretto.
- o Assicurarsi che la portata ed il tipo di fusibili siano quelli prescritti dalla casa costruttrice.
- o L'apparecchiatura deve avere un collegamento di messa a terra ben eseguito; anche la connessione rete deve avere un collegamento a terra.
- o Il cavo di alimentazione a corredo dell'apparecchiatura deve essere collegato come segue:
Filo tensione—Marrone Neutro—Blu Massa—Verde/Giallo

AVISO IMPORTANTE DE SEGURIDAD

Esta unidad cumple con la norma de seguridad EN60065. La unidad no debe ser expuesta a goteos o salpicaduras y no deben colocarse sobre el equipo recipientes con líquidos, como tazas de café. Para asegurarse un funcionamiento seguro y prevenir cualquier posible peligro de descarga o riesgo de incendio, se han de observar las siguientes precauciones:

E

- o Asegúrese que el selector de tensión esté ajustado a la tensión correcta para su alimentación.
- o Asegúrese que los fusibles colocados son del tipo y valor correctos, tal como se marca en la unidad.
- o La unidad debe ser puesta a tierra, conectándola a un conector de red correctamente cableado y puesto a tierra.
- o El cable de red suministrado con esta unidad, debe ser cableado como sigue:
Vivo—Marrón Neutro—Azul Tierra—Verde/Amarillo

VIKTIGA SÄKERHETSÅTGÄRDER!

Denna enhet uppfyller säkerhetsstandard EN60065. Enheten får ej utsättas för yttre åverkan samt föremål innehållande vätska, såsom kaffemuggar, får ej placeras på utrustningen. För att garantera säkerheten och gardera mot eventuell elchock eller brandrisk, måste följande observeras:

S

- o Kontrollera att spänningsväljaren är inställd på korrekt nätspänning.
- o Kontrollera att säkringarna är av rätt typ och för rätt strömstyrka så som anvisningarna på enheten föreskriver.
- o Enheten måste vara jordad genom anslutning till ett korrekt kopplat och jordat el-uttag.
- o El-sladden som medföljer denna enhet måste kopplas enligt följande:
Fas—Brun Neutral—Blå Jord—Grön/Gul

BELANGRIJK VEILIGHEIDS-VOORSCHRIFT:

Deze unit voldoet aan de EN60065 veiligheids-standaards. Dit apparaat mag niet worden blootgesteld aan vocht. Vanwege het risico dat er druppels in het apparaat vallen, dient u er geen vloeistoffen in bekertjes op te plaatsen. Voor een veilig gebruik en om het gevaar van elektrische schokken en het risico van brand te vermijden, dienen de volgende regels in acht te worden genomen:

NL

- o Controleer of de spanningscarroussel op het juiste Voltage staat.
- o Gebruik alleen zekeringen van de aangegeven typen en waarden.
- o Aansluiting van de unit alleen aan een geaarde wandcontactdoos.
- o De netkabel die met de unit wordt geleverd, moet als volgt worden aangesloten:
Fase—Bruin Nul—Blauw Aarde—Groen/Geel

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Introduction

Welcome to Dolby® professional video!

The Dolby Professional Reference Monitor (PRM-4220) is designed for the postproduction, film, and television broadcast industries. The PRM-4220 has a resolution of $1,920 \times 1,080$ pixels and a refresh rate of 120 Hz, utilizing Dolby Laboratories' dual-modulation RGB backlight technology. This enables the 42-inch (diagonal) flat-panel display to deliver extended dynamic range and reveal true and deep blacks with higher contrast across its entire color gamut. The PRM-4220 complies with the industry standard color primaries (ITU-R BT.709 [also referred to as Rec. 709], DCI P3, SMPTE-C, and EBU) and accepts the CIE 1931 XYZ color space. We designed the PRM-4220 to equal or exceed the performance characteristics of a reference CRT display. In addition, the PRM-4220 can emulate consumer LCD and plasma display panel (PDP) displays, providing the colorist with an immediate quality control reference point while in the grading suite. With the use of custom 3D lookup tables (LUTs), the PRM-4220 can also display other user-specified properties.



Figure 1-1 PRM-4220 Front Panel

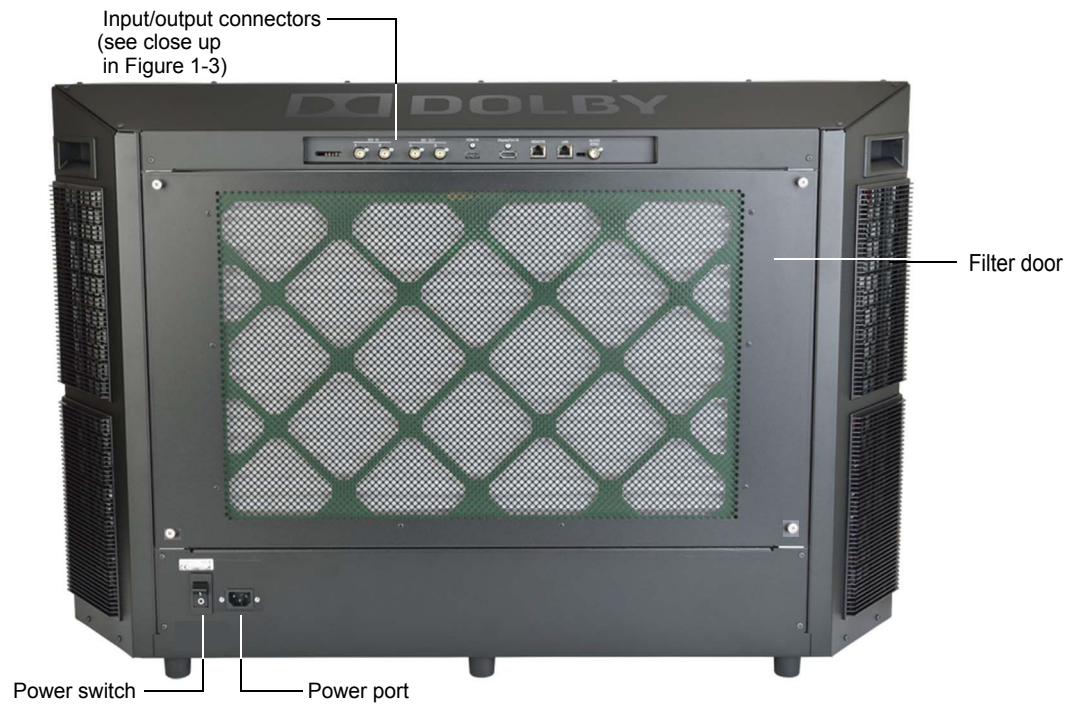


Figure 1-2 PRM-4220 Rear Panel

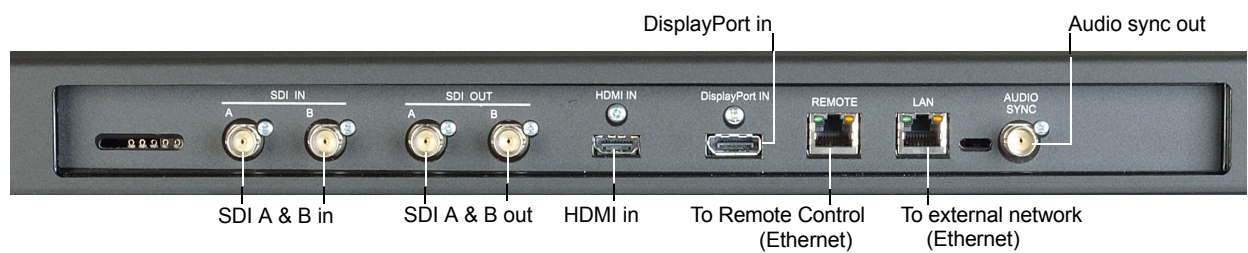


Figure 1-3 PRM-4220 Rear-Panel Connectors (Enlarged and Labeled)

You operate the PRM-4220 using the Dolby Remote Control. You can use the Remote on the desktop or mounted in a standard 19-inch equipment rack. For complete details on the Remote, see [Chapter 2](#).

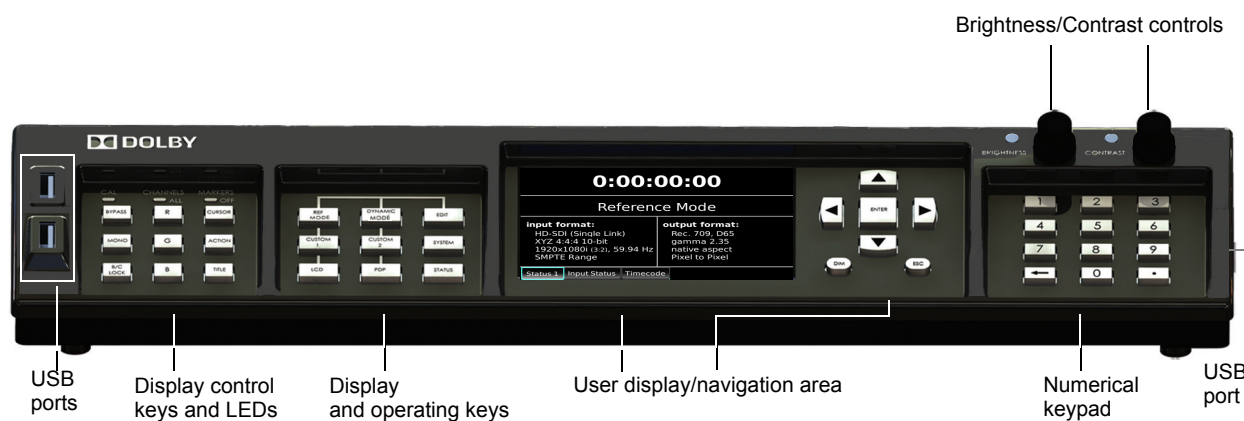


Figure 1-4 Remote Front Panel

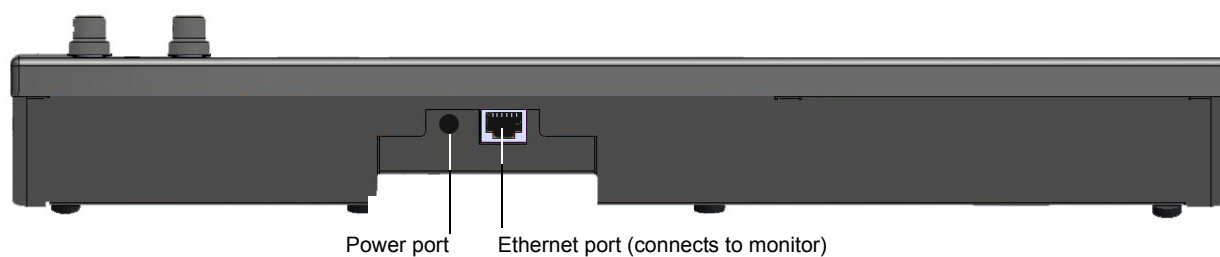


Figure 1-5 Remote Rear Panel

Using the Professional Reference Monitor

This chapter explains how to use the Dolby® PRM-4220.

2.1 Installing the PRM-4220

To install the Dolby PRM-4220:

1. Position the PRM-4220 in a well-ventilated area, at a minimum of 12 inches from a side wall and 12 inches from a rear wall. In addition, if you install the PRM-4220 in any type of enclosure, air should flow into the enclosure at a minimum of 200 cubic feet per minute with air at 25°C (77°F). Be sure that no exhaust air recirculates to the intake on the rear panel (see [Figure 2-1](#)).



Note: We recommend that you maintain a room temperature near 25°C.

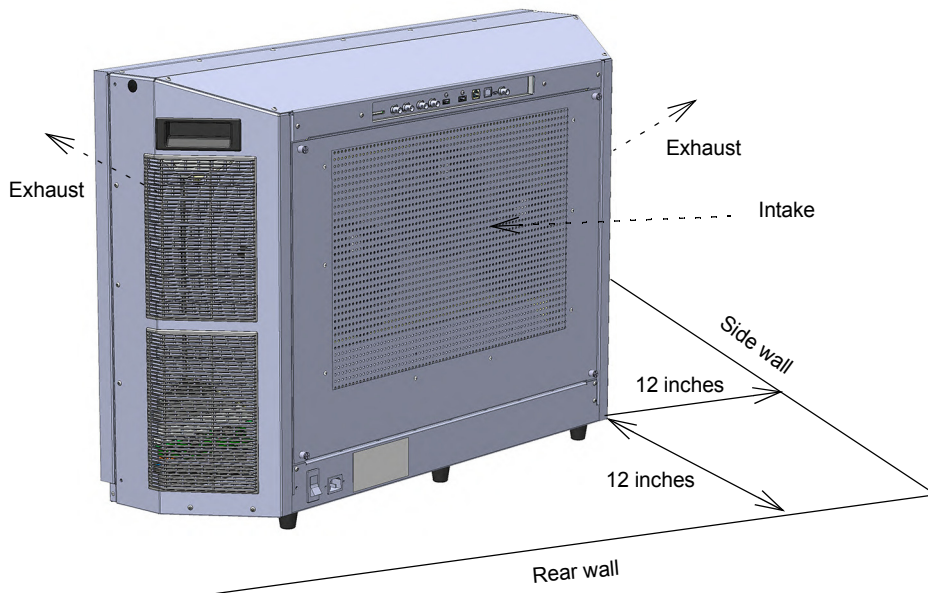


Figure 2-1 PRM-4220 Ventilation Requirements



Note: For the PRM-4220 dimensions, see [Figure B-1](#).

2. Connect your required inputs and outputs on the PRM-4220 rear panel, as shown in [Figure 2-2](#).

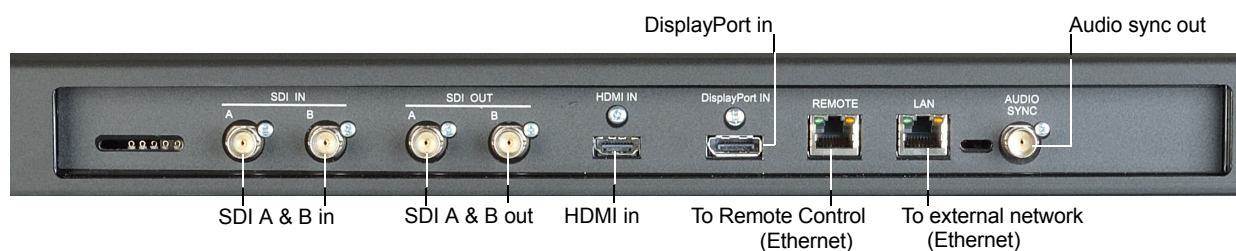


Figure 2-2 Connect Inputs and Outputs

Use the SDI A input for single-link formats. Use the SDI A and B inputs for dual-link formats.



Note: To use the SDI inputs, you need to configure the HD-SDI link mode and HD-SDI link format parameters, as described in [Section 2.4.4](#) and [Section 2.4.5](#).

3. Connect the Remote Control to the PRM-4220 using the provided Ethernet cable, and then connect the provided power adapter to an AC power source and connect the Remote to the DC side of the power adapter, as shown in [Figure 2-3](#).

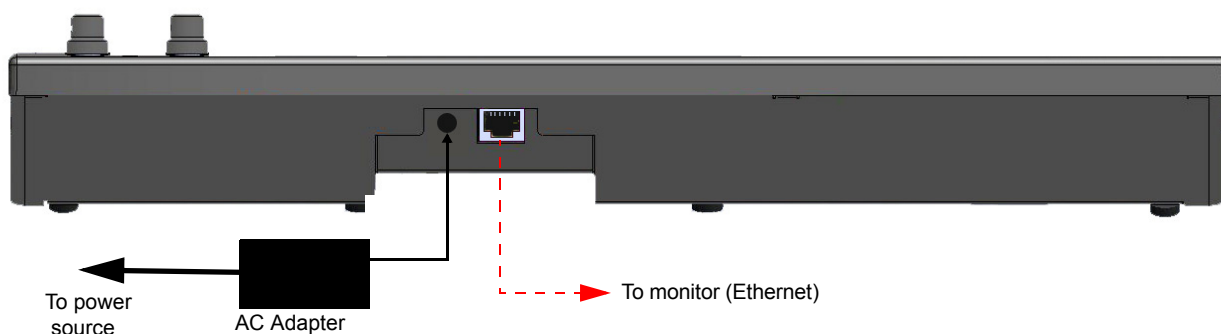


Figure 2-3 Connecting the Remote Rear-Panel Ports

4. Connect the PRM-4220 power cable to an AC power source, then press the power switch to turn on the monitor, as shown in [Figure 2-4](#).

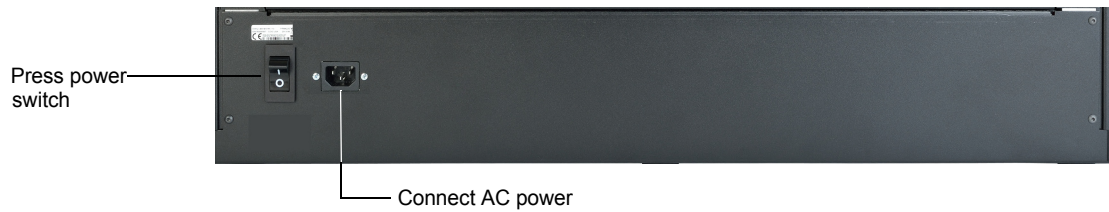


Figure 2-4 Connect AC Power and Turn On Monitor

While the Remote is booting, the Dolby logo appears on its user display, and then a message indicates that it is searching for a connected monitor, as shown in [Figure 2-5](#). In addition, the Remote software version appears at the lower-left corner of the screen.

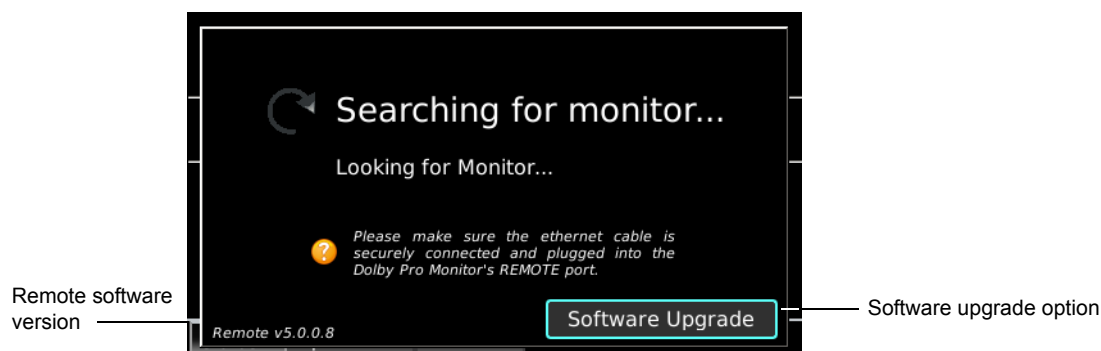


Figure 2-5 Searching for Monitor Screen



Note: The message in [Figure 2-5](#) remains on the screen if the monitor is not powered up or the Remote is not connected to the **REMOTE** port on the monitor. It also remains on the screen if the Remote and the monitor have different software versions (with an additional message indicating this incompatibility). A **Software Upgrade** option appears at the lower-right corner of this screen. For information on upgrading the monitor and the Remote at the same time or only the Remote, see [Software Upgrade](#).

When the Remote recognizes the PRM-4220, the Dolby logo appears, and then the **Reference Mode Status 1** screen appears, as shown in [Figure 2-6](#) for an HD-SDI single-link input.

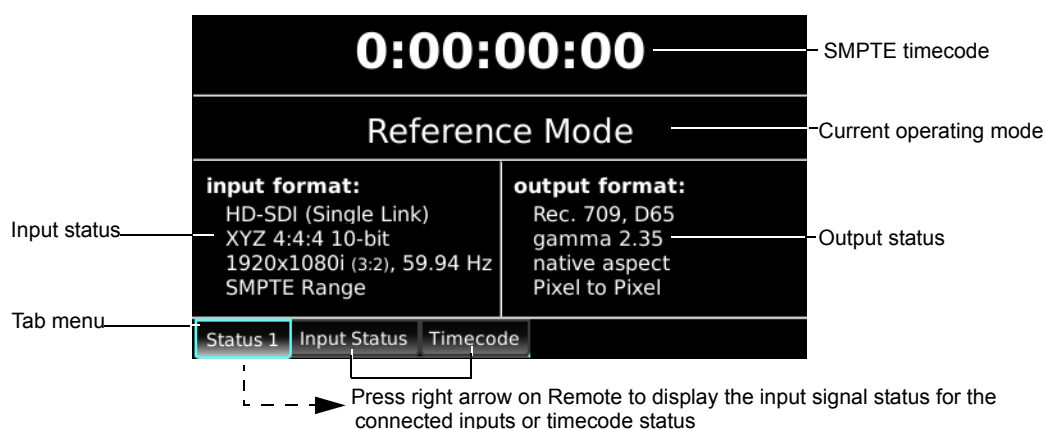


Figure 2-6 Reference Mode Status 1 Screen (HD-SDI Input Source)

If you press the right arrow key on the Remote to select **Input Status**, the respective input signal status appears, as shown in [Figure 2-7](#).

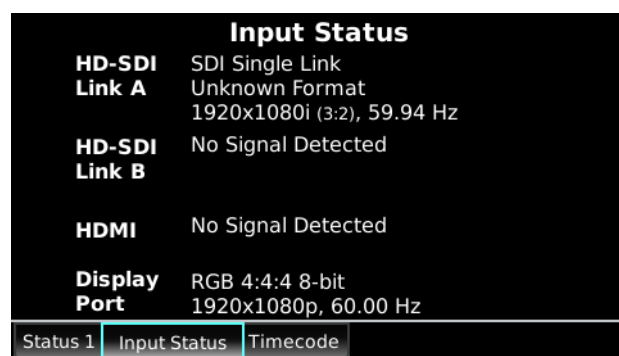


Figure 2-7 Input Status Screen

Reference mode is the default PRM-4220 display mode. The other display modes (Dynamic, liquid crystal display [LCD], plasma display panel [PDP], Custom 1, Custom 2) display similar information in their respective status screens. Tab menus provide access to the appropriate parameters and other information as you move from screen to screen. Each mode and its corresponding parameters are described in detail later in this chapter. [Section 2.2](#) shows you how to use the Remote to operate the PRM-4220.

2.2 Remote Control Basics

The Remote is designed for use on a desktop or in a standard 19-inch equipment rack. (Screw holes are provided on each side of the Remote for rack installations.) You can access the most frequently used functions through front-panel buttons, and additional functions are accessible in menus that appear on the user display. There are no onscreen display menus provided on the monitor itself, but you can use the Remote to access action-safe and title-safe markers and selected pixels on the PRM-4220 screen.

The Remote front panel provides the following sections of logically grouped functions, as shown in Figure 2-8:

- Display control
- Display and operating modes
- User display and navigation
- Numerical keypad for entries and presets

Each of these sections contains function-related keypads, which are easily accessible in low-light conditions. You press on a key to activate the respective function. Some of the keys illuminate when activated.

The **BRIGHTNESS** and **CONTRAST** controls are located above the keypad.

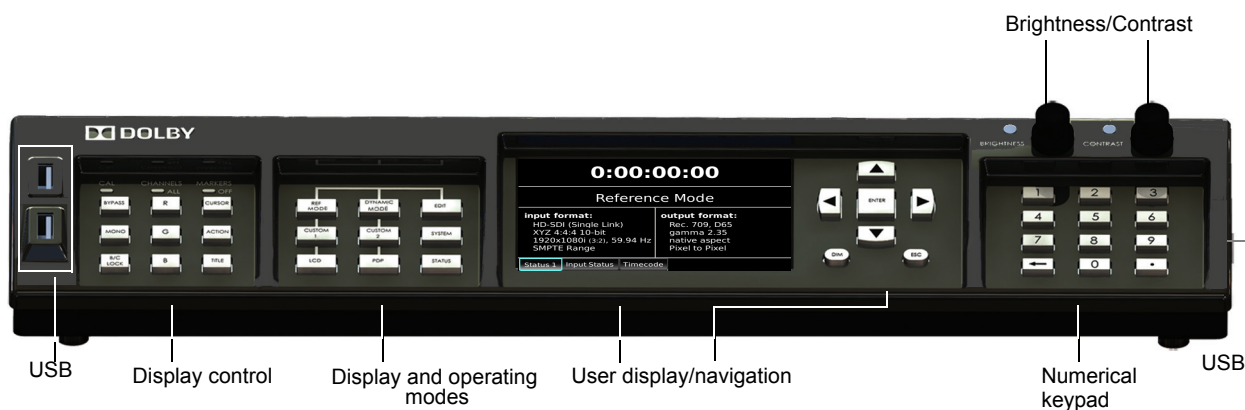


Figure 2-8 Remote Front Panel

Following is an overview of each function area on the Remote.

2.2.1 Display Control Section

Three LEDs appear at the top of the Display Control section: **CAL**, **CHANNELS ALL**, and **MARKERS OFF**. Three keys below each LED control the corresponding functions. Following is a description of each LED and its respective function keys.

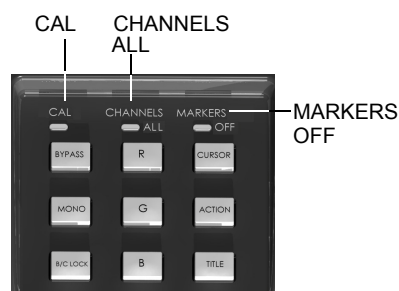


Figure 2-9 Control Functions

Cal



This red LED:

- Illuminates when you change the default brightness, contrast, or RGB gain calibration settings.
- Turns off when you restore the default calibration settings manually (see [Manual Calibration](#)) or automatically (see [Factory Reset](#)). To restore only the brightness and contrast defaults, press **ENTER** when a dialog appears during the brightness and contrast adjustment process.

Table 2-1 Calibration Key Descriptions

Key	Function	Illumination	Notes
BYPASS 	Bypasses user-customized brightness, contrast, and RGB gain settings only	Yellow when enabled, turns off when disabled	Press this key to return the PRM-4220 to its original default calibration settings (if you modified these settings).
MONO 	Specifies a monochromatic display for the currently enabled channel (R,G, or B)	Yellow when enabled, turns off when disabled	
B/C LOCK 	Enables/disables the rotary knobs for BRIGHTNESS and CONTRAST controls	Yellow when enabled, turns off when disabled	

Channels All



This blue LED:

- Illuminates when all three color channels (red, green, and blue) are enabled.
- Turns off when you select a single color channel (red, green, or blue).

Table 2-2 Channels All Key Descriptions

Key	Function	Illumination	Notes
R 	Selects red channel only, disables green and blue channels; when disabled, returns the PRM-4220 to all color channels on	Yellow when enabled, turns off when disabled	You can select only one color channel at a time.
G 	Selects green channel only, disables red and blue channels; when disabled, returns the PRM-4220 to all color channels on	Yellow when enabled, turns off when disabled	You can select only one color channel at a time.
B 	Selects blue channel only, disables red and green channels; when disabled, returns the PRM-4220 to all color channels on	Yellow when enabled, turns off when disabled	You can select only one color channel at a time.

Markers Off



This blue LED:

- Illuminates when all of the onscreen markers are deactivated.
- Turns off when one of the three onscreen markers is activated.

Table 2-3 Markers Off Key Descriptions




Key	Function	Illumination	Notes
CURSOR 	Shows pixel cursor on the PRM-4220 screen when enabled	Yellow when enabled, turns off when disabled	The Pixel Cursor screen appears on the Remote, as shown in the example in Figure 2-10 . In this screen, you can enter x/y coordinates to position the pixel cursor on the PRM-4220 screen. Use the arrow keys or the numerical keypad to adjust the values. Press ENTER to toggle between x and y. <div data-bbox="948 772 1374 1012" data-label="Image"> </div>
ACTION 	Shows action-safe markers on the PRM-4220 screen when enabled	Yellow when enabled, turns off when disabled	
TITLE 	Shows title-safe markers on the PRM-4220 screen when enabled	Yellow when enabled, turns off when disabled	

Figure 2-10 Pixel Cursor Screen

2.2.2 Display and Operating Modes Section

This section of the Remote provides access to the PRM-4220 display modes (reference, dynamic, user-loaded 3D LUT, and emulation modes), and the operating modes (edit, system, and status). You activate each of these modes by pressing its corresponding key, which illuminates in yellow.

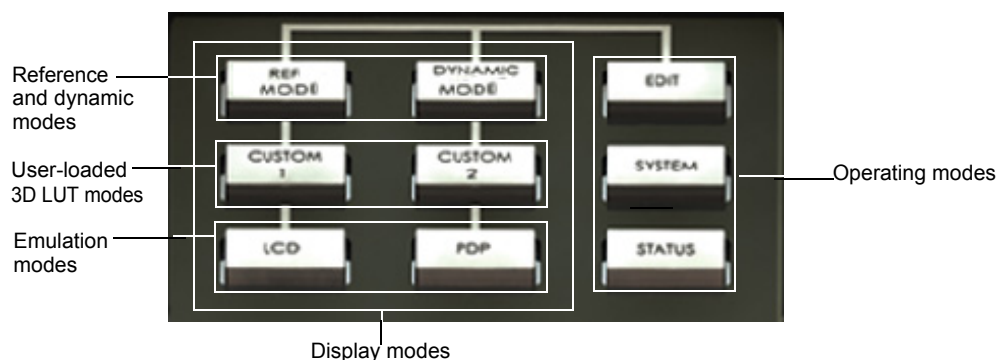


Figure 2-11 Display Modes and Operating Modes

Display Mode Keys

Following is a description of the display mode keys.

Reference Mode and Dynamic Mode Keys

The Reference (**REF**) and Dynamic modes provide highly accurate colorimetry and gray-scale performance. They allow a user to modify display-related parameters only (brightness, contrast, and maximum luminance), and to toggle between two groups of display-related settings. We created these modes for the colorist, as the main work areas. Following is a description of these two modes:

REF MODE

This mode provides a maximum luminance of 120 cd/m², continuously variable from 40 cd/m².

DYNAMIC MODE

This mode provides a maximum luminance of 600 cd/m², continuously variable from 40 cd/m².

User-Loaded 3D LUT MODES

These two custom modes apply user-loaded 3D look-up tables (LUTs) to display the desired properties (for example, a film stock look, another display device, or other user-specified properties). For information on loading custom LUTs, see [Load LUTs](#).

CUSTOM 1

CUSTOM 2

Emulation Mode Keys

The emulation modes use LUTs that are preloaded on the system to duplicate the colorimetry of a specific display type. There are two emulation modes:

LCD

This mode emulates the properties of an LCD.

PDP

This mode emulates the properties of a plasma display.

Operating Mode Keys

The operating modes provide access to the PRM-4220 settings. Following is a description of the operating mode keys:



EDIT

This mode allows you to edit Reference mode, Dynamic mode, user-loaded 3D LUT (Custom 1 and 2) mode, and LCD and PDP emulation mode parameters, as described in [Section 2.3](#).



SYSTEM

This mode allows you to access and configure the PRM-4220 global settings (those settings that are not accessible using the **EDIT** key). Typically, you specify the system settings at the beginning of a session, and these settings do not change during the session. For complete details on the **SYSTEM** key functions, see [Section 2.4](#).



STATUS

The **STATUS** key displays the PRM-4220 core operating parameters for the selected display mode. (See the example for Reference mode in [Figure 2-6](#).) It also provides access to a SMPTE timecode display.

2.2.3 Remote Control LCD

The Remote LCD provides screens and menus that allow you to access, edit, and configure many PRM-4220 parameters.

2.2.4 Navigation Keys

You use the navigation keys to move through menu options, tabs, and screens that appear on the Remote user display.



Figure 2-12 Navigation Keys

- The up and down arrow keys illuminate in yellow when you use them to enter data in dialog boxes.
- The left and right arrow keys illuminate in yellow when you use them to adjust values in slider display screens.
- You press the **ENTER** key to activate a data entry field, to confirm or save parameter changes, and to exit some screens. When you press this key, it illuminates in yellow.
- You can use the **DIM** key to dim the Remote LED and LCD preset brightness levels. When you press **DIM**, the system uses the levels set in the **Remote Settings** screen, as shown in [Figure 2-41](#).
- You can use the **ESC** key to exit a dialog box without saving changes. However, if you make changes in a dialog box and press **ENTER** before pressing **ESC**, the system saves the changes.

2.2.5 Numerical Keys



Figure 2-13 Numerical Keypad

You use the numerical keys to enter values in the Remote data entry fields. You can use the backspace key in the lower-left corner to delete characters from right to left.

Using the Numerical Keys to Save Custom Presets

You can also use the numerical keys to save and load custom presets, as described in [Section 2.5](#). Each preset saves the current state of all PRM-4220 parameters. You can configure many of these parameters using the Remote **EDIT** and **SYSTEM** menus. For more information on configuring these parameters, see [Section 2.3](#) and [Section 2.4](#).

2.2.6 Brightness and Contrast Controls

The **BRIGHTNESS** and **CONTRAST** control knobs (see [Figure 2-8](#)) have dedicated blue LEDs. The respective LED illuminates when you turn a knob out of the default center detent position. The LED is off when a knob is in the center detent position.

The **BRIGHTNESS** control sets the black level. It adds or subtracts an offset in the red, green, and blue channels. When adjusting this control, the black picture content should appear as true black on the PRM-4220. After setting the brightness correctly, you should set the contrast for comfortable viewing brightness.

The **CONTRAST** control sets the white level. It applies a scale factor (gain) to the red, green, and blue channels. This affects the luminance (proportional to intensity) that the system reproduces for a full white input signal.

You can lock the **BRIGHTNESS** and **CONTRAST** control knobs by pressing the **B/C LOCK** key in the Control section on the Remote (see [Figure 2-9](#)). This lock prevents accidental changes to the settings. The **B/C LOCK** key illuminates in yellow when activated.

2.2.7 Ethernet Port

The Remote has one RJ45 port for connecting to the PRM-4220 using a dedicated point-to-point network connection. The Remote communicates with the PRM-4220 through this 10/100Base-T connection using the provided Cat. 5e twisted-pair cable. The transport and network layers are TCP/IP. The Remote IP address is statically configured at the factory; no user intervention is required for the Remote to communicate with the PRM-4220.

2.2.8 USB Ports

The Remote has three USB 2.0 compliant ports. Two are located on the left side of the Remote front panel (oriented vertically), and one is located on the right side panel.

The USB ports are provided to connect memory devices. You can insert USB memory devices to save 1D and 3D LUTs (to the PRM-4220, not on the Remote), to save user-defined presets, and to upgrade the system.

2.2.9 Rackmount or Tabletop Use

You can use the Remote on a tabletop or mounted in a standard 19-inch equipment rack. Screw holes are provided on each side of the Remote for rack installations. When rackmounted, the Remote requires two standard rackspace.

2.3 Editing the Display Mode Parameters

You can edit the PRM-4220 display mode parameters using the Remote. [Table 2-4](#) lists the edit parameters for the Reference, Dynamic, Custom 1 and Custom 2 (user-provided 3D LUT), LCD, and PDP display modes.

Table 2-4 Display Mode Edit Parameters

Reference	Dynamic	Custom 1 and 2	LCD	PDP
Input Format	Input Format	Input Format	Input Format	Input Format
Video Range	Video Range	Video Range	Video Range	Video Range
SDI Input	SDI Input	SDI Input	SDI Input	SDI Input
Brightness	Brightness	Brightness	Brightness	Brightness
Contrast	Contrast	Contrast	Contrast	Contrast
Luminance	Luminance	Luminance		



Note: You can activate only one mode at a time by pressing its respective key. When you press a key, it illuminates in yellow. Enabling one mode disables any other mode.

2.3.1 Editing the Reference Mode Parameters

To edit the Reference mode parameters:

1. Press the **REF MODE** key, then press the **STATUS** key.

The **Reference Mode Status 1** screen displays the current input and output formats, as shown in [Figure 2-14](#).

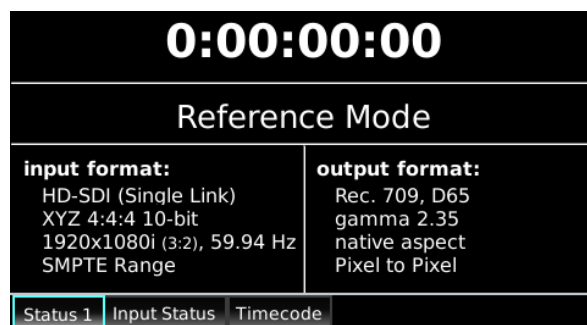


Figure 2-14 Reference Mode Status Screen

2. Press the **EDIT** key, as shown in [Figure 2-15](#).



Figure 2-15 Accessing the Reference Mode Parameters

This key illuminates in yellow and the **Reference Mode: Input** screen appears with **Input Format** and **Video Range** parameters, as shown in [Figure 2-16](#). The **Input** tab at the bottom-left side of the screen is highlighted, indicating it is the active menu selection.

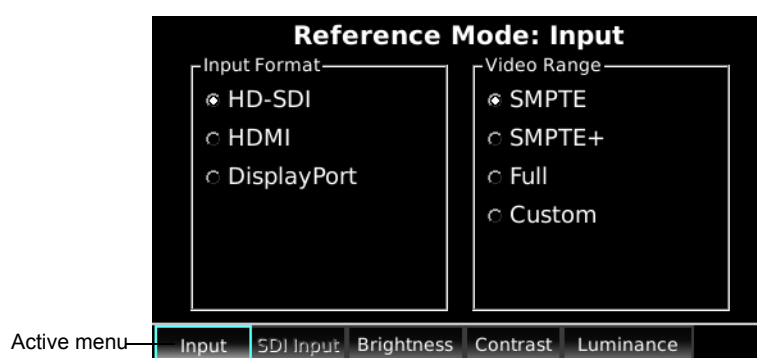


Figure 2-16 Reference Mode: Input Screen



Note: The **SMPTE+ Video Range** setting provides SMPTE black with full-range white (for example, 8-bit SMPTE + RGB 16–255 white).

- To change a current setting, press the up/down arrow keys to highlight the desired parameter, and then press **ENTER**.
If you select **Custom**, the **Custom Video Range** screen appears, as shown in [Figure 2-17](#).

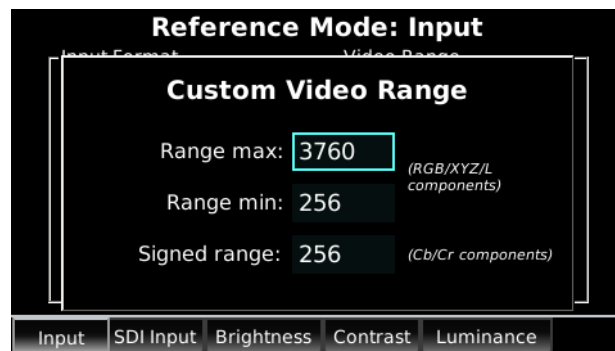


Figure 2-17 Custom Video Range Screen

In this screen, you can enter the desired video range settings by using the arrow keys to select each field and pressing **ENTER** to activate the field. The up/down arrow keys illuminate, indicating you can use these to increase/decrease each value. To scroll up and down through the range of values, press and hold the arrow keys. Alternatively, you can use the numeric keypad to directly enter the desired value. To save your entries, press **ENTER** again.

You can display another reference screen by pressing the down arrow key until you activate the tab menu, and then pressing the right/left arrow keys or the **EDIT** key.



Caution: The system saves your changes in an edit screen only when you press **ENTER**. You can quit any screen by pressing the **ESC** key.

- Press the down arrow key to activate the tab menu, then press the right arrow key (or the **EDIT** key).

If two single-link HD-SDI inputs are connected (A and B), the **SDI Input** screen appears. You can connect two single-link 1.5G-SDI inputs or two single-link 3GA-SDI inputs. In this screen, you can switch between links, as shown in [Figure 2-18](#). This tab is inaccessible (grayed out) when only one HD-SDI input is connected or if you select HDMI™ or DisplayPort as the input source (or you are working in dual-link mode).

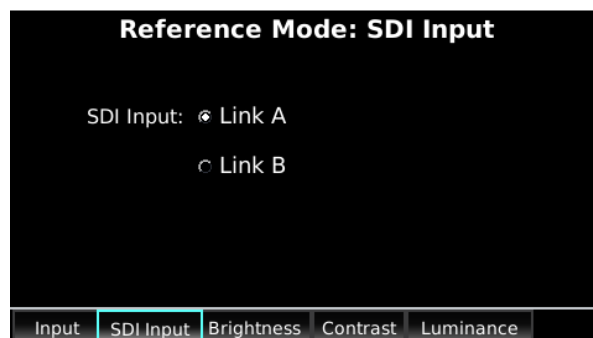


Figure 2-18 Reference Mode: SDI Input Screen

5. Press the down arrow key to activate the tab menu, then press the right arrow key (or the **EDIT** key).

The **Reference Mode: Brightness** screen appears with a slider display, which indicates the current brightness setting, as shown in [Figure 2-19](#).

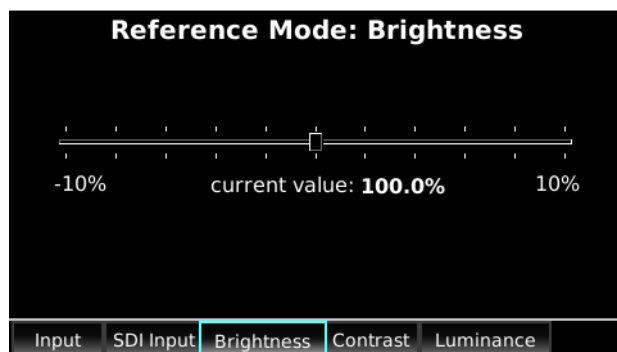


Figure 2-19 Reference Mode: Brightness Screen

6. To change the current brightness setting:
 - If the **B/C LOCK** (third key below **CAL**) is illuminated, press this key to unlock the brightness control. This lock prevents accidental changes to the brightness setting.
 - Turn the **BRIGHTNESS** control knob (located above the numeric keypad) to move the slider to the desired value, and then press **ENTER**.
 - To lock in your new settings, press the **B/C LOCK** key.

When you change the default brightness setting, the LED next to its control knob illuminates in blue.

7. Press the right arrow key (or the **EDIT** key).

The **Reference Mode: Contrast** screen appears with a slider display, which indicates the current contrast setting, as shown in [Figure 2-20](#).

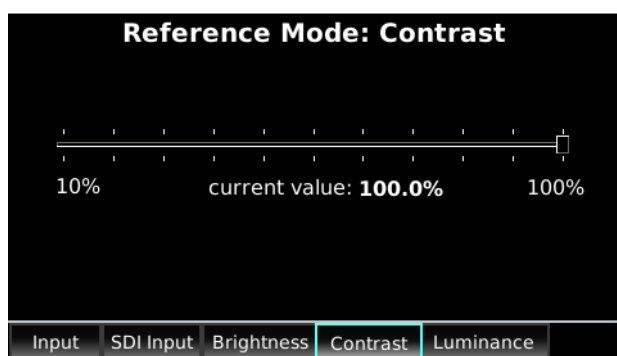


Figure 2-20 Reference Mode: Contrast Screen

8. To change the current contrast setting:
 - If the **B/C LOCK** (third key below **CAL**) is illuminated, press this key to unlock the contrast control. This lock prevents accidental changes to the contrast setting.
 - Turn the **CONTRAST** control knob (located above the numeric keypad) to move the slider to the desired value, and then press **ENTER**.
 - To lock in your new settings, press the **B/C LOCK** key.

When you change the default contrast setting, the LED next to its rotary control knob illuminates in blue.

9. Press the right arrow key (or the **EDIT** key).

The **Reference Mode: Max Luminance** screen appears. In this screen, you can change the maximum luminance value for the PRM-4220, as shown in [Figure 2-21](#).

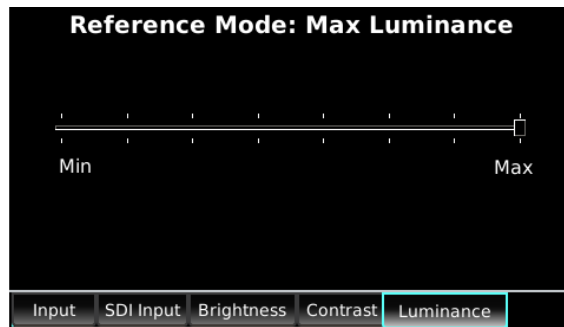


Figure 2-21 Reference Mode: Maximum Luminance Screen

10. Press **ENTER** twice to activate the slider, then use the illuminated left and right arrow keys to change your setting, and press **ENTER** again to save.

2.3.2 Editing the Dynamic Mode Parameters

Dynamic mode moves the display into a higher dynamic range. In this mode, the black level remains constant as the allowable maximum luminance level increases. The white point and primary locations also remain constant.

To edit the Dynamic mode parameters:

1. Press the **DYNAMIC MODE** key.

If you are already in edit mode, the input format and video range parameters appear, which are the same as in the **Reference Mode** status screen.

If you are not in edit mode, press the **STATUS** key to display the **Dynamic Mode** status screen, as shown in [Figure 2-22](#), then press the **EDIT** key to display the corresponding input format and video range parameters.

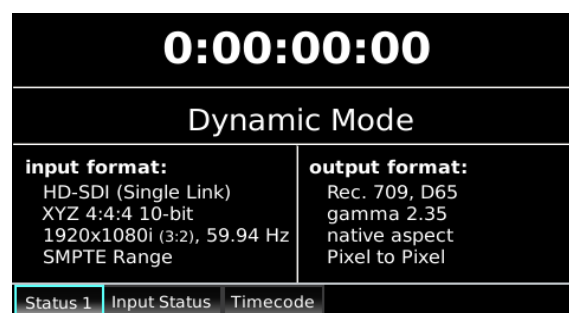


Figure 2-22 Dynamic Mode Status Screen

Dynamic Mode Input Format, SDI Input, Video Range, Brightness, and Contrast

When you press the **EDIT** key, these Dynamic mode parameters and their respective screens are almost identical to those in the Reference mode (described in [Section 2.3.1](#)). The one exception is the maximum luminance, as described next.

Dynamic Mode Maximum Luminance

The Dynamic mode maximum peak luminance (600 cd/m²) is greater than in Reference mode (120 cd/m²). In this mode, you can change the maximum peak luminance value using the slider (see [Figure 2-23](#)), as described previously for Reference mode in [Section 2.3.1](#).

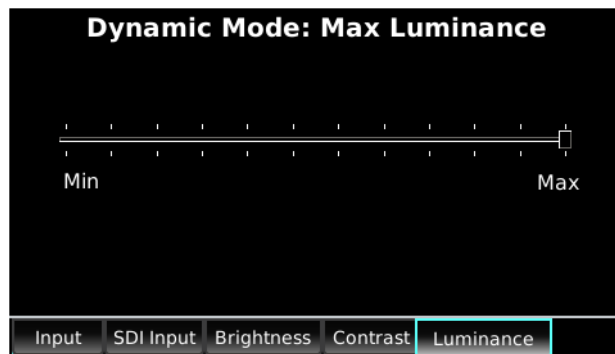


Figure 2-23 Dynamic Mode: Maximum Luminance Screen

White Point Dependency

In Dynamic mode, the maximum attainable luminance changes when you adjust the white point. For information on setting the white point, see [Section 2.4.2](#).

2.3.3 Editing the LCD, PDP, and Custom Parameters

These modes are defined as follows:

- LCD mode uses a factory supplied 3D LUT that is representative of consumer LCDs.
- PDP mode uses a factory supplied 3D LUT that is representative of consumer plasma displays.
- Custom 1 and Custom 2 modes use custom 3D LUTs to provide user-specific display properties. For information on loading custom LUTs, see [Load LUTs](#).

The parameters for all of these modes are identical. To edit these parameters:

1. Press the desired emulation key (**LCD** or **PDP**) or user-loaded 3D LUT key (**CUSTOM 1** or **CUSTOM 2**), and then press the **STATUS** key.

The respective status screen displays the current input and output formats, as shown in [Figure 2-24](#) for the **LCD Emulation Mode** status screen.

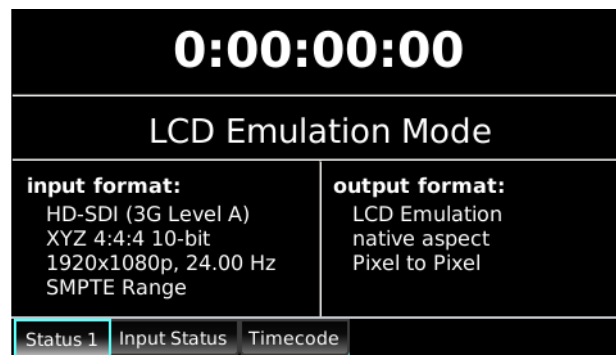


Figure 2-24 LCD Emulation Mode Status Screen

LCD, PDP, Custom 1 and Custom 2 Input Format, SDI Input, Video Range, Brightness, and Contrast

When you press the **EDIT** key, these parameters and their respective screens are almost identical to those in the Reference mode (described in [Section 2.3.1](#)). The one exception is the luminance parameter, which is inaccessible in LCD and PDP modes.

2.4 Configuring the System Parameters

You configure the PRM-4220 system parameters using the Remote. The system parameters apply to global operations and functions. Most of these parameters apply to the entire monitor system. However, some of the system parameters apply only to Reference mode or Dynamic mode.

2.4.1 Configuring the Primaries

To configure these parameters:

1. Press the **SYSTEM** key to activate the tab menu, then use the arrow keys (or the **SYSTEM** key) to move to the **Primaries** tab.

The **Primaries** screen appears, as shown in [Figure 2-25](#). The primaries represent the chromaticity coordinates for the RGB and YCbCr inputs. You can change the current setting by pressing the up/down arrow keys to highlight the desired parameter, and then pressing **ENTER**.

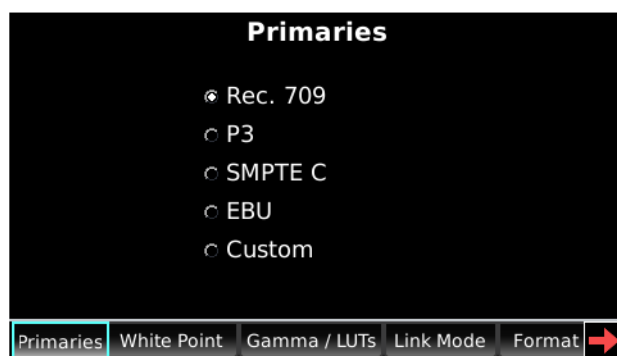


Figure 2-25 System/Primaries Screen

If you select **Custom**, a screen appears where you can specify the desired primary CIE x and y coordinates for red, green, and blue, as shown in [Figure 2-26](#).

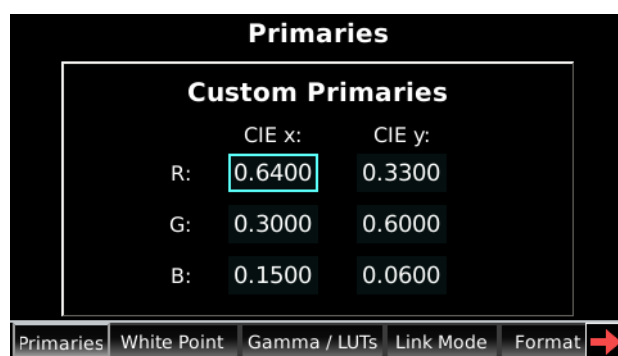


Figure 2-26 System/Primaries/Custom Primaries Screen



Note: The **Primaries** tab is inaccessible when the input is XYZ or when an emulation mode or a user-loaded 3D LUT custom mode is active. In such cases, the primaries are absolute.

2. Use the arrow keys, and press **ENTER** to activate a field, then use the arrow keys or the keypad to change a setting, and press **ENTER** again to save. When using the arrow keys:
 - A single up-arrow key press increases the current value by 0.0001.
 - A single down-arrow key press decreases the current value by 0.0001.
 - Pressing and holding the up arrow for more than 1.5 seconds increases values continuously by 0.001.
 - Pressing and holding the down arrow for more than 1.5 seconds decreases values continuously by 0.001.



Note: If a setting is invalid, the corresponding x and y coordinates are outlined in red and you must change them to compatible values before saving.

Following is the valid range of values for custom primaries (see [Figure 2-27](#)):

Red

(x = 0.6800, y = 0.3200)

(x = 0.6197, y = 0.3738)

(x = 0.5928, y = 0.2772)

Green

(x = 0.2650, y = 0.6900)

(x = 0.3731, y = 0.5936)

(x = 0.2337, y = 0.5183)

Blue

(x = 0.1500, y = 0.0600)

(x = 0.2020, y = 0.0855)

(x = 0.1605, y = 0.1175)

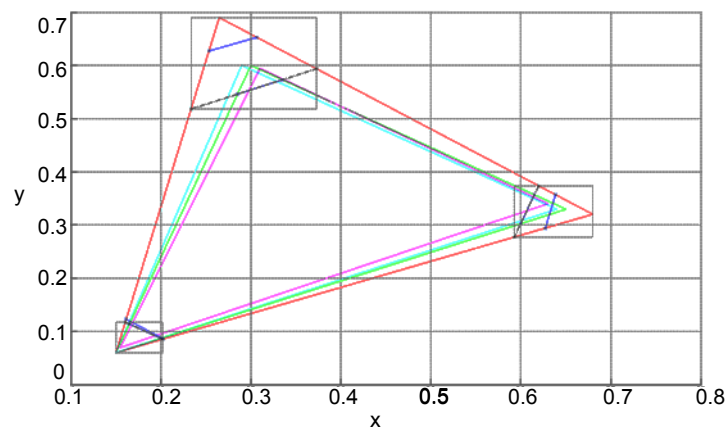


Figure 2-27 Custom Primaries Limits

2.4.2 Configuring the White Point

To configure this parameter:

1. Press the **SYSTEM** key to activate the tab menu, then use the arrow keys (or the **SYSTEM** key) to move to the **White Point** tab.

The **White Point** screen appears.

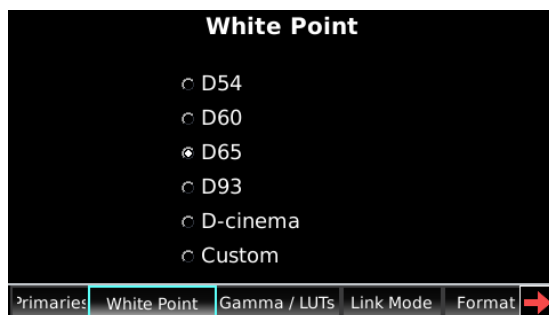


Figure 2-28 System/White Point Screen

The white point sets the chromaticity of white for the RGB and YCbCr inputs. You can change the current setting by pressing the up and down arrow keys, and then pressing the **ENTER** key.



Note: The **White Point** tab is inaccessible when the input is XYZ or when an emulation mode or a user-loaded 3D LUT custom mode is active. In such cases, the white point is absolute.

If you select **Custom**, a screen appears where you can specify the desired white point CIE x and y coordinates, as shown in [Figure 2-29](#).

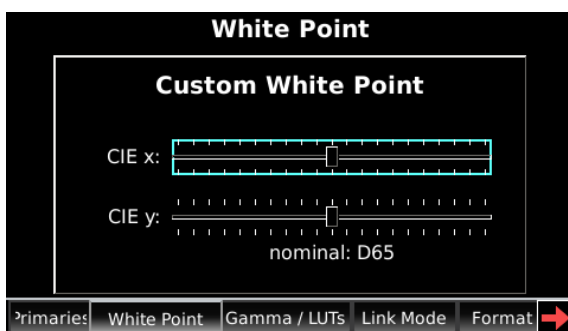


Figure 2-29 System/White Point/Custom White Point Screen

2. To configure a custom white point, use the up/down arrow keys and press **ENTER** to activate the desired slider (see [Figure 2-29](#)), then use the left/right arrow keys to change a setting, and press **ENTER** again to save. When using the arrow keys:
 - A single right-arrow key press increases the current value by 0.0001.
 - A single left-arrow key press decreases the current value by 0.0001.
 - Pressing and holding the right arrow for more than 1.5 seconds increases values continuously by 0.001. The maximum value is 0.5.
 - Pressing and holding the left arrow for more than 1.5 seconds decreases values continuously by 0.001. The minimum value is 0.2.

2.4.3 Configuring the Gamma

To configure this parameter:

1. Press the **SYSTEM** key to activate the tab menu, then use the arrow keys (or the **SYSTEM** key) to move to the **Gamma/LUTs** tab.

The **Gamma** screen appears, with **Pure Gamma** and **Custom LUT** parameters, as shown in [Figure 2-30](#).



Note: The **Gamma/LUTs** tab is inaccessible when an emulation mode or a user-loaded 3D LUT mode is active. In such cases, the gamma is absolute.



Note: Pure gamma on the monitor refers to power function gamma. True Rec. 709 and sRGB specification gamma requires the use of a 1D LUT.

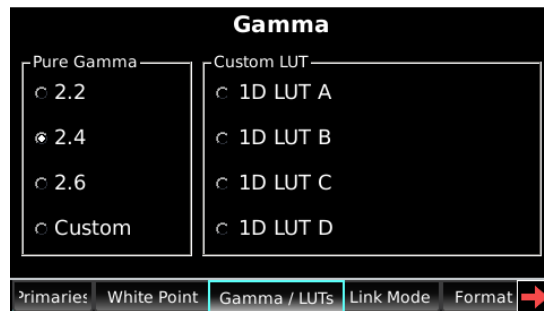


Figure 2-30 System/Gamma Screen

In this screen, you can use the arrow keys to specify a pure gamma or a 1D custom LUT gamma that was loaded from a USB storage device. (See [Loading a 1D LUT](#).) Press the **ENTER** key to save.

If you select **Custom**, a screen appears where you can specify the desired gamma, as shown in [Figure 2-31](#).

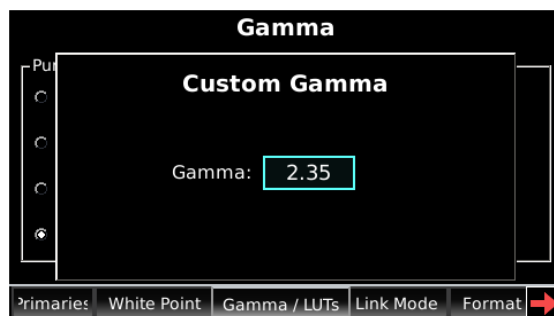


Figure 2-31 System/Gamma/Custom Gamma Screen

2. Use the arrow keys or the numeric keypad to change the setting, and press **ENTER** again to save. When using the arrow keys:
 - A single up-arrow key press increases the current value by 0.01.
 - A single down-arrow key press decreases the current value by 0.01.
 - Pressing and holding the up arrow for more than 1.5 seconds increases values continuously by 0.1. The maximum value is 3.
 - Pressing and holding the down arrow for more than 1.5 seconds decreases values continuously by 0.1. The minimum value is 2.2.

2.4.4 Configuring the HD-SDI Link Mode

To configure this parameter, press the **SYSTEM** key to activate the tab menu, then use the arrow keys (or the **SYSTEM** key) to move to the **Link Mode** tab.

The **HD-SDI Link Mode** screen appears, as shown in [Figure 2-32](#). In this screen, you can specify the HD-SDI input mode.

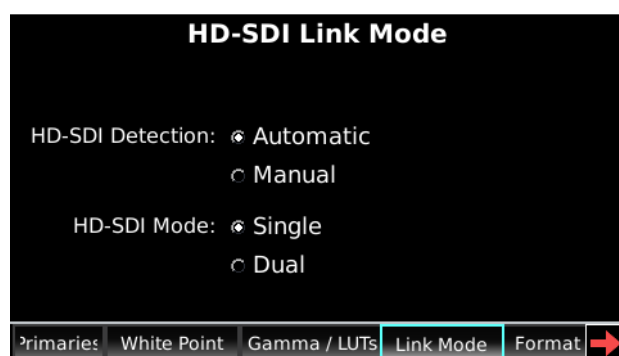


Figure 2-32 System/HD-SDI Link Mode Screen



Caution: If you change the HD-SDI link mode, you must select the appropriate HD-SDI link format, as shown in [Figure 2-33](#).

You can change the current settings by pressing the arrow keys, and then pressing the **ENTER** key.

HD-SDI Detection Automatic specifies that the system automatically detects the input mode (**Single** or **Dual**). **HD-SDI Detection Manual** allows you to select the input mode and specify a compatible input format in the **HD-SDI Link Format** screen (shown in [Figure 2-33](#)). The system can accept the input as dual-link HD-SDI when one of the following conditions applies:

- **HD-SDI Detection** is set to **Manual**, **HD-SDI Link Mode** is set to **Dual**, and the system detects sources on both the SDI A and SDI B inputs.
- **HD-SDI Detection** is set to **Automatic**, and the SDI A and SDI B inputs receive SMPTE 352 payload identifier channel assignments that specify both channel 1 and channel 2.

In all other cases, the system ignores the SDI B input and accepts the SDI A input (if present) as a single-link input.

2.4.5 Configuring the HD-SDI Link Format

To configure this parameter, press the **SYSTEM** key to activate the tab menu, then use the arrow keys (or the **SYSTEM** key) to move to the **Format** tab. The **HD-SDI Link Format** screen appears, as shown in [Figure 2-33](#).

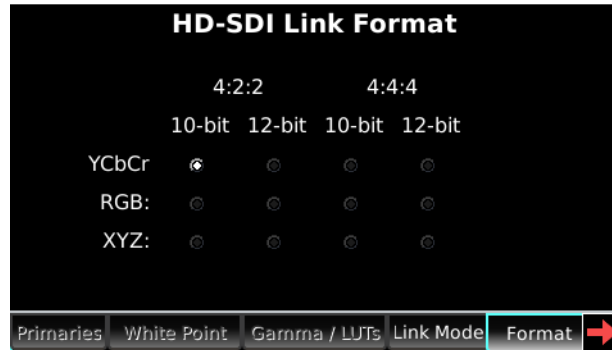


Figure 2-33 System/HD-SDI Link Format Screen

In this screen, you can specify the input format if **HD-SDI Detection** is set to **Manual**. You can also specify the input format if **HD-SDI Detection** is set to **Automatic**, but the SMPTE payload identifier channel assignments are missing or incomplete (see [Figure 2-32](#)).

You can change the current **4:2:2** and **4:4:4** settings by pressing the arrow keys, and then pressing the **ENTER** key. A grayed-out field indicates that it is incompatible with the currently selected HD-SDI link mode and input format.



Caution: If you change the HD-SDI link format, you must select the appropriate HD-SDI link mode, as shown in [Figure 2-32](#).



Note: If you set the HD-SDI link format to XYZ, the primaries and white point parameters are inaccessible.

2.4.6 Configuring Aspect Ratio and Scaling

To configure these parameters, press the **SYSTEM** key to activate the tab menu, then use the arrow keys (or the **SYSTEM** key) to move to the **Aspect/Scaling** tab.

The **Aspect Ratio and Scaling** screen appears, as shown in [Figure 2-34](#).

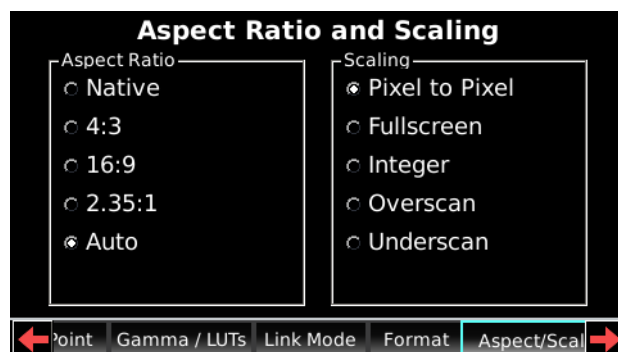


Figure 2-34 Aspect Ratio and Scaling Screen

You can change the current **Aspect Ratio** and **Scaling** settings by pressing the arrow keys, and then pressing the **ENTER** key.

Aspect Ratio configures the screen image using asymmetrical scaling. This process performs a vertical stretch on input formats that have nonsquare pixels (to maintain the correct aspect ratio) and retains the horizontal resolution. For example, a standard definition source such as 720×480 has a horizontal-to-vertical pixel ratio of 3:2, but appears in a 4:3 aspect ratio. In this case, asymmetrical scaling converts the image to 720×540 .

If you set the **Aspect Ratio** to **Auto**, the system uses the aspect ratio defined by the video input.

Scaling configures the screen image, adjusting the horizontal and vertical dimensions symmetrically:

- **Pixel to Pixel** maps input pixels to output pixels with no scaling. For example, a $1,280 \times 720$ source is mapped to the middle 67% of the $1,920 \times 1,080$ raster.
- **Fullscreen** scales the source by the required scale factor to fill at least one dimension of the $1,920 \times 1,080$ raster. For example, the system scales up a $1,280 \times 720$ source by 1.5. For 2K sources that are not cropped by the 2K image position setting (see [Figure 2-39](#)), the system scales down to $1,920 \times 1,080$. All other formats scale up.
- **Integer** scales the source as close as possible to the full $1,920 \times 1,080$ raster using an integer scale factor. For example, the system scales up a 640×480 source by two, displaying a $1,280 \times 960$ active image in the center of the $1,920 \times 1,080$ raster.
- **Overscan** is full-screen mode plus a scale factor that decreases the size of the picture by 5%.
- **Underscan** is full-screen mode plus a scale factor that increases the size of the picture by 5% and crops to $1,920 \times 1,080$.

2.4.7 Configuring the Action and Title Safe Area Markers

To configure these parameters, press the **SYSTEM** key to activate the tab menu, then use the arrow keys (or the **SYSTEM** key) to move to the **Safe Markers** tab.

The **Action/Title Safe Area Markers** screen appears, as shown in [Figure 2-35](#). In this screen, you can specify SMPTE RP 218:2002 recommended action-safe and title-safe areas or SMPTE EG 2046-3:2010 recommended action-safe and title-safe areas, or you can create custom markers.



Figure 2-35 Action/Title Safe Area Markers Screen

If you select **Custom**, a screen appears where you can specify the desired position (x and y coordinates) and size (width and height) for a custom marker, as shown in [Figure 2-36](#). We recommend that you begin by entering the size of your custom marker, and then entering the x/y position values.

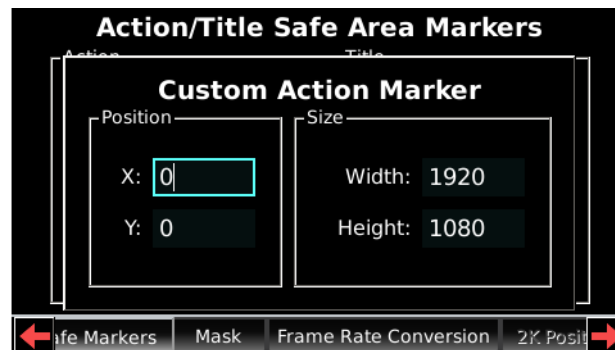


Figure 2-36 Custom Action Marker

When setting these values:

- **Position** specifies where the marker appears on the monitor.
X specifies the distance from the left side of the monitor to the left side of the marker.
Y specifies the distance from the top of the monitor to the top of the marker.
- **Size** specifies the relative width and height of the marker that appears on the monitor.

Use the numeric keypad or the arrow keys to configure the custom action marker parameters, and press **ENTER** again to save.

2.4.8 Configuring the Marker Mask

To configure these parameters, press the **SYSTEM** key to activate the tab menu, then use the arrow keys (or the **SYSTEM** key) to move to the **Mask** tab.

The **Marker Mask** screen appears, as shown in [Figure 2-37](#). In this screen, you can shade regions outside the selected marker and define the opacity for the shading.

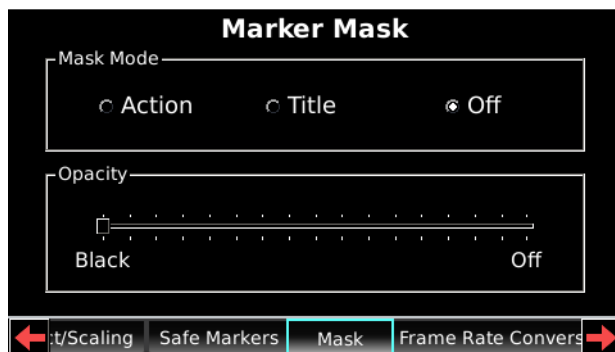


Figure 2-37 Marker Mask Screen

2.4.9 Configuring the Frame Rate Conversion

The PRM-4220 is a progressive display device that converts interlaced video to a progressive format using a scanning format converter. When the input is progressive, the signal passes straight through the system. To configure these parameters, press the **SYSTEM** key to activate the tab menu, then use the arrow keys (or the **SYSTEM** key) to move to the **Frame Rate Conversion** tab.

The **Frame Rate Conversion** screen appears, as shown in [Figure 2-38](#). In this screen, you can configure **Deinterlacing** and **3:2 Pull-down**.

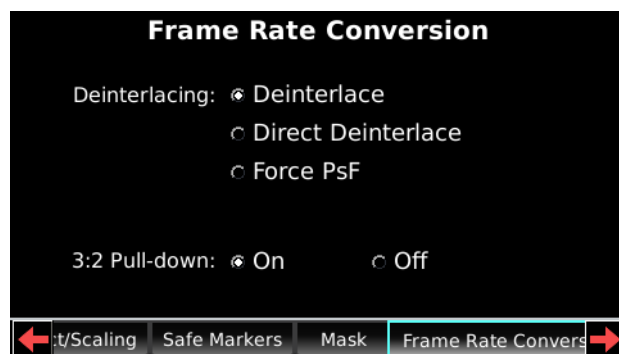


Figure 2-38 System/Frame Rate Conversion Screen

You can change the current settings by pressing the arrow keys, and then pressing the **ENTER** key.

Deinterlacing options:

- **Deinterlace** converts interlaced video to progressive output using a motion-adaptive deinterlacer. This process utilizes motion-detection intelligence to adapt field combination with spatial filtering at the pixel level, which minimizes the undesirable side effects of traditional deinterlacers.
- **Direct Deinterlace** converts interlaced video to progressive output using black-line insertion. The system converts each field of the input source to a full frame and fills in undefined lines with black data. This operation performs no image signal processing.
- **Force PsF** forces the PRM-4220 to operate in progressive segmented frame (PsF) mode if the connected hardware does not send the correct PsF flag in the video bitstream.

3:2 Pull-down option:

- **3:2 Pull-down** converts 59.94i and 60i input formats that originated from 23.98p and 24p, respectively (as detected by the system), back to their original progressive formats. This process constructs each frame of the progressive output from the appropriate odd and even fields of the input source.

2.4.10 Configuring the 2K Image Position

To configure this parameter:

1. Press the **SYSTEM** key to activate the tab menu, then use the arrow keys (or the **SYSTEM** key) to move to the **2K Position** tab.

If the system detects a 2K input source, the **2K Image Position** screen appears, as shown in [Figure 2-39](#). This screen is inaccessible (grayed out) for HDMI and DisplayPort inputs. In this screen, you can change the current settings.

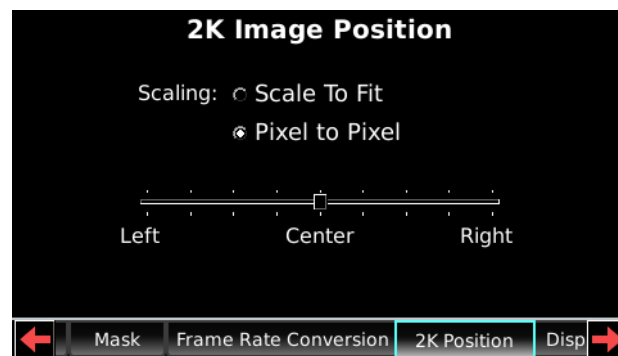


Figure 2-39 System/2K Image Position Screen

- **Scale To Fit** scales a 2K image horizontally and vertically so that the entire 2K image fits across the visible area of the 1,920 × 1,080 screen. Symmetrical black bars appear on the top and bottom of the screen.
 - **Pixel to Pixel** displays a 2K image by centering it within the 1,920 × 1,080 active display screen. Typically, the system conceals 128 pixels on the left side and 128 pixels on the right side of the 2K image. However, you can use the adjustable slider to view any of the 128 pixels on the left and right side of the 2K image.
2. To change the current setting, use the arrow keys, then press **ENTER**.
 3. To activate the slider, press the down arrow key, press **ENTER**, and then use the left and right arrow keys to move the slider:

- Each time you press the right arrow key to increase a value or the left arrow key to decrease a value, the marker moves in one-pixel increments.
- When you press and hold an arrow key for 1.5 seconds, the marker moves ten pixels.

As you move the slider, the screen image responds in real time. The **Pixel to Pixel** slider position determines which pixels the system conceals from each line.

4. Press **ENTER** to save your settings.

2.4.11 Configuring the On-screen Display

To configure this parameter:

1. Press the **SYSTEM** key to activate the tab menu, then use the arrow keys (or the **SYSTEM** key) to move to the **Display** tab.

The **On-screen Display** parameters appear, as shown in [Figure 2-40](#). In this screen, you can change the current settings.

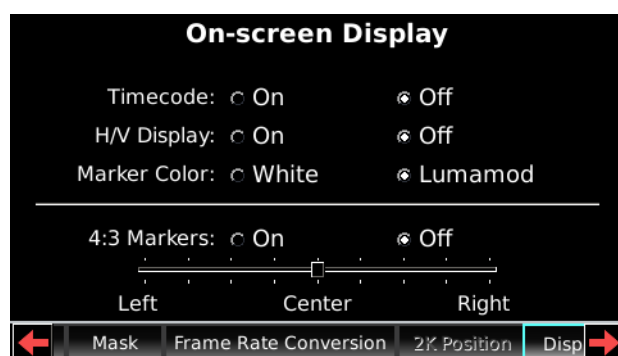


Figure 2-40 System/On-Screen Display Parameters

Timecode specifies whether to display timecode information on the PRM-4220 screen.

H/V Display specifies whether to offset the image (horizontally and vertically) to show blanking intervals and all ancillary data.

Marker Color specifies the color of the onscreen pixel cursor and markers (action, title, and 4:3). Selecting **Lumamod** draws each pixel in black or white, depending on the overlaid pixel in the video content. If the marker pixel replaces a video pixel with a luminance value greater than 50%, the system draws the pixel in black. Selecting **White** draws the pixel in white.

2. To change the current settings, use the arrow keys.
3. To activate the **4:3 Markers** slider, use the arrow keys to highlight the slider, press **ENTER**, and select **On**. Use the left and right arrow keys to move the slider from left to right:
 - Each time you press the right arrow key to increase a value or the left arrow key to decrease a value, the marker moves in one-pixel increments.
 - When you press and hold an arrow key for 1.5 seconds, the marker moves ten pixels.
 - As you move the **4:3 Markers** slider, the markers displayed on the PRM-4220 screen move from side to side in real time.
4. Press **ENTER** to save your settings.

2.4.12 Configuring the Remote Settings

You use these settings to specify the LED and LCD brightness for the Remote Control (not the PRM-4220).

To configure these parameters:

1. Press the **SYSTEM** key to activate the tab menu, then use the arrow keys (or the **SYSTEM** key) to move to the **Remote** tab.

The **Remote Settings** screen appears, as shown in [Figure 2-41](#).

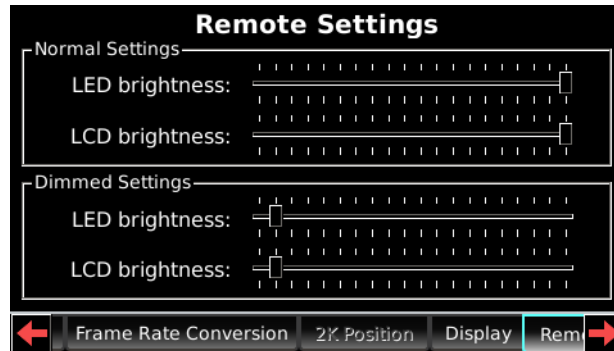


Figure 2-41 Remote Settings Screen

You can change the Remote **LED brightness** and **LCD brightness** settings for both **Normal Settings** and **Dimmed Settings** by pressing the arrow keys, pressing **ENTER**, pressing the arrow keys again to move each slider, and pressing **ENTER** again to save. The system retains your settings when rebooting and updating the software. When using the arrow keys:

- A single right-arrow key press increases the current value, while a single left-arrow key press decreases the current value.
 - Pressing and holding the right arrow scrolls up through the available range.
 - Pressing and holding the left arrow scrolls down through the available range.
2. Press the **DIM** button on the Remote front panel (next to the **ESC** key) to preview your settings.

2.4.13 Configuring the Calibration Reset

To configure these parameters:

1. Press the **SYSTEM** key to activate the tab menu, then use the arrow keys (or the **SYSTEM** key) to move to the **Calibration** tab.

The **Calibration/Reset** screen appears, as shown in [Figure 2-42](#). You can select a calibration option by pressing the arrow keys, and then pressing the **ENTER** key.

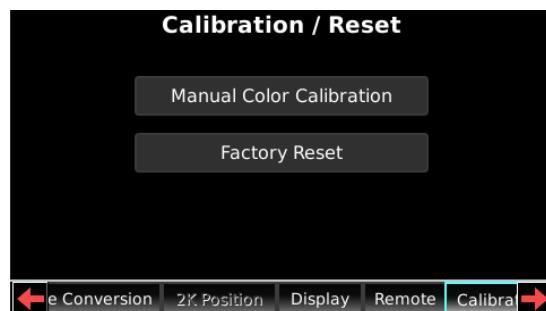


Figure 2-42 System/Calibration/Reset Screen

Manual Calibration

When you select this option, the **Manual Calibration** screen appears, as shown in [Figure 2-43](#). In this screen, you can reduce the red, green, and blue gain values from their default (100%) settings.

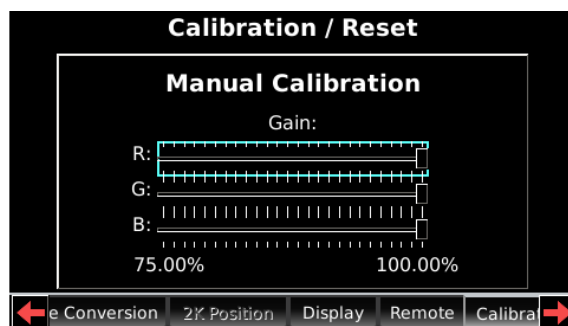


Figure 2-43 System/Calibration/Reset/Manual Calibration Screen

To manually calibrate the settings:

- Use the arrow keys to select the **R**, **G**, or **B** slider, then press **ENTER**.
- Press and hold the right arrow key once to increase the current value by 0.1%.
- Press and hold the left arrow key once to decrease the current value by 0.1%.
- Press and hold the right arrow for more than 1.5 seconds to increase values continuously by 0.1%.
- Press and hold the left arrow for more than 1.5 seconds to decrease values continuously by 0.1%.
- Press **ENTER** again to save.

Factory Reset

When you select this option, a confirmation prompt appears, as shown in [Figure 2-44](#). Select **OK** to reset the PRM-4220 to its original factory settings or **Cancel** to retain the current settings, then press **ENTER**.

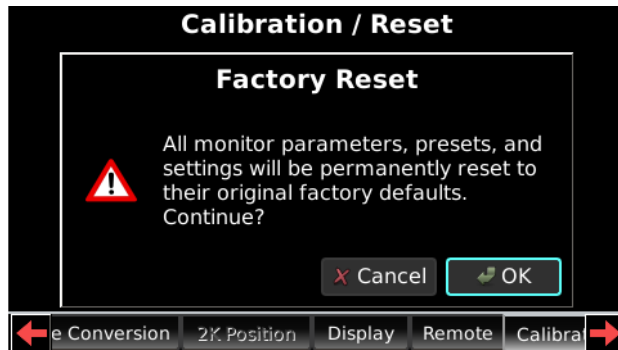


Figure 2-44 System/Calibration/Reset/Factory Reset Screen



Note: To maintain optimal performance, we recommend that you have your PRM-4220 calibrated once each year by a Dolby technician. For more information, contact your authorized Dolby technical representative.

2.4.14 Running the System Utilities

To run these utilities, press the **SYSTEM** key to activate the tab menu, then use the arrow keys (or the **SYSTEM** key) to move to the **Utilities** tab.

The **Utilities** screen appears, as shown in [Figure 2-45](#). You can select a utility option by pressing the arrow keys, and then pressing the **ENTER** key.

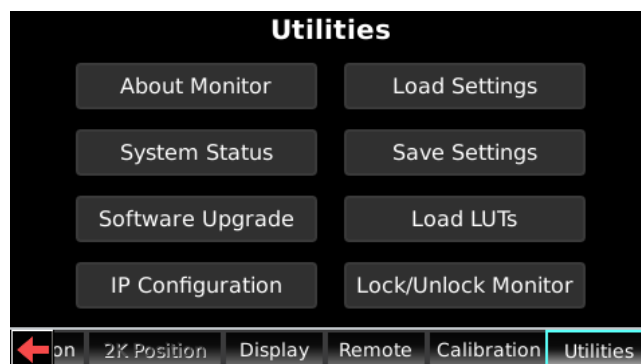


Figure 2-45 System/Utilities Screen

About Monitor

When you select this option, the **About this PRM-4220** screen appears, as shown in [Figure 2-46](#). This screen displays the PRM-4220 serial number and the system software, which is the same for the monitor and the Remote.

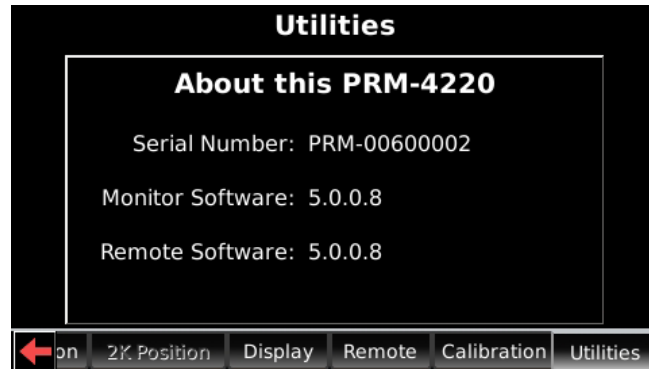


Figure 2-46 System/Utilities/About This PRM-4220 Screen

System Status

When you select this option, the **System Status** screen appears. You can scroll through the list to check the status of each of the displayed items, as shown in [Figure 2-47](#).

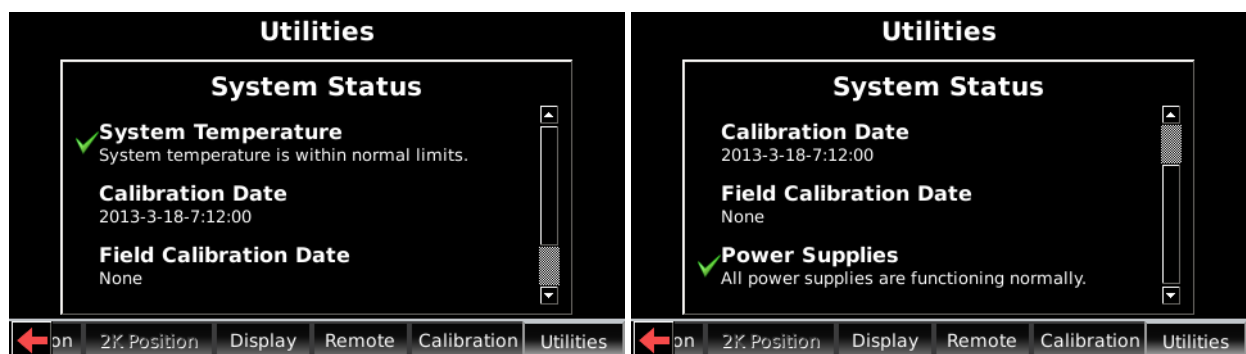


Figure 2-47 System Status Screens

Software Upgrade

You can upgrade or downgrade the system software on the Remote and the monitor at the same time or you can upgrade or downgrade a stand-alone Remote that is not connected to a monitor.

Before you begin the upgrade:

- Be sure the unit is on stable power.
- Save a preset settings backup file.
- Follow the correct upgrade path from the installed software version to the updated software. Not doing so can result in Remote connection errors. Refer to the release notes included with the updated software for compatibility details.

To install the system software for both the monitor and the Remote:

1. Obtain the software upgrade .dlb file from www.dolbycustomer.com (you will need to register and establish your user credentials), copy it to a USB device, and then insert the device into one of the Remote USB ports.
2. Select **System > Utilities > Software Update**.

The **Software Upgrade** screen appears, as shown in [Figure 2-48](#). In this screen, you can upgrade or downgrade the PRM-4220 and Remote system software.

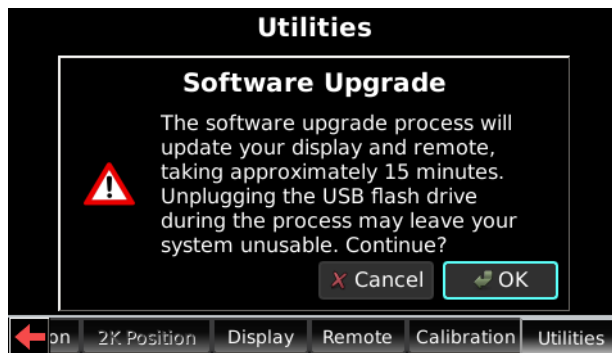


Figure 2-48 Software Upgrade Screen

3. Use the arrow keys to select **OK**, then press **ENTER**.
The USB device appears, as shown in [Figure 2-49](#).

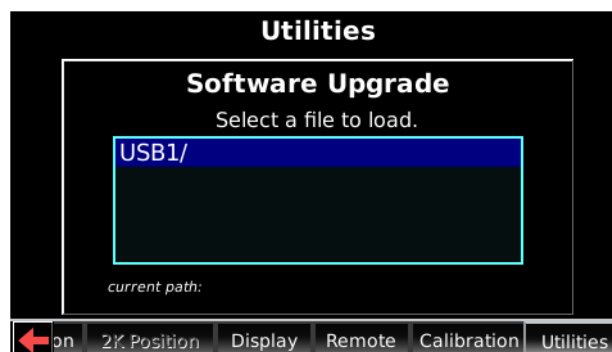


Figure 2-49 USB Device Screen

4. Press **ENTER** to display the files on the USB device, then use the arrow keys to select the upgrade file, as shown in [Figure 2-50](#).

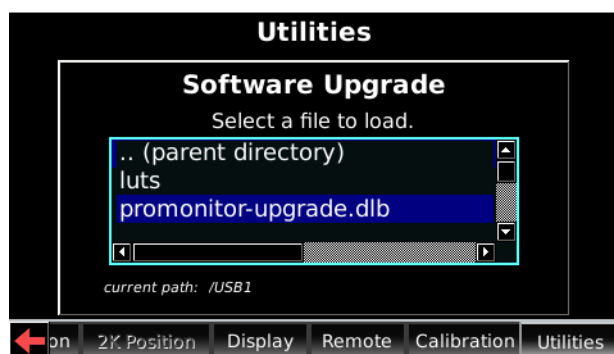


Figure 2-50 Select a File to Load Screen

5. Press **ENTER**.
A confirmation prompt appears, as shown in [Figure 2-51](#).

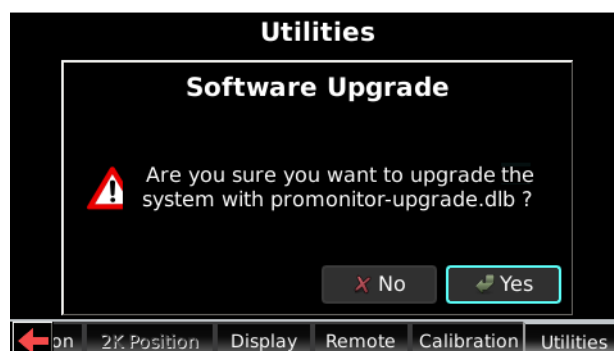


Figure 2-51 Software Upgrade Confirmation Screen

6. Use the arrow keys to select **Yes**, then press **ENTER**.
The system begins the software upgrade. During the upgrade process, a progress bar moves slowly, stopping at 50% and at other points. When the progress bar reaches 100%, it remains on the screen for a while. Do not remove the USB device until the upgrade is completed and the system reboots the monitor (approximately 25 minutes).

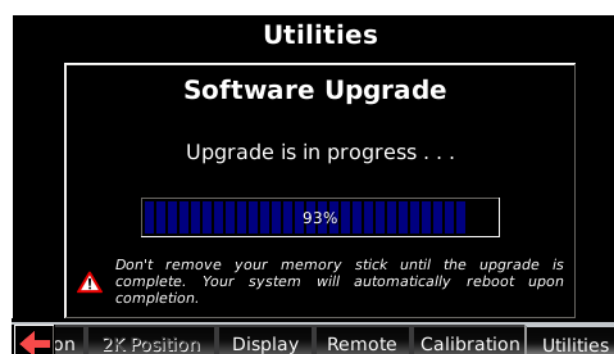


Figure 2-52 Upgrade Is in Progress Screen

The system can take up to two minutes to reboot the monitor. As the monitor is rebooting, the Remote screen fades and turns off, and then the Dolby logo appears on the screen. The Remote searches, and once communication is established with the monitor, the **REF MODE** status screen appears.

7. Select **System > Utilities > About Monitor** to confirm that the updated software is installed on both the Remote and the monitor.

To install the system software on a stand-alone Remote that is not connected to a monitor (or is connected to a monitor that is not powered on):

1. Power up the Remote.

When the **Searching for monitor** screen appears, the currently installed Remote software version appears at the lower-left corner and a **Software Upgrade** option appears at the lower-right corner.

2. Press **ENTER**.

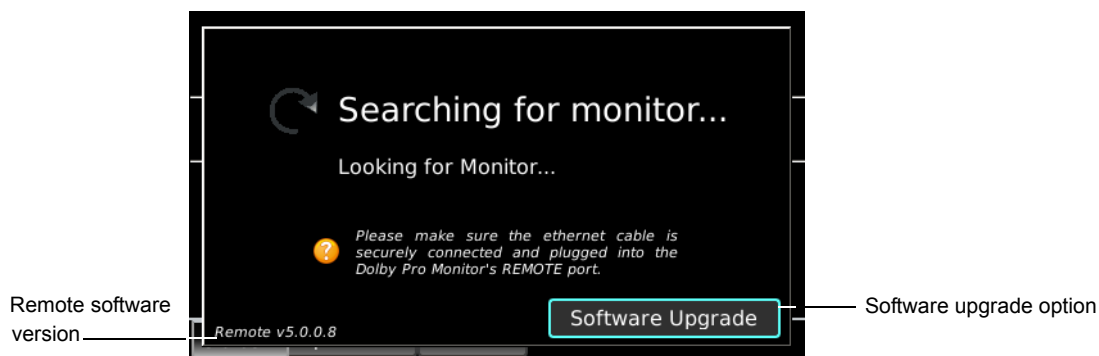


Figure 2-53 Stand-Alone Remote Software Upgrade Screen 1

The **Software Upgrade** screen for the Remote appears.



Figure 2-54 Stand-Alone Remote Software Upgrade Screen 2

3. Use the arrow keys to select **OK**, then press **ENTER**.

Follow the same instructions, as previously described for installing the system software on both the Remote and the monitor. Do not remove the USB device until the upgrade is completed (approximately five minutes for the stand-alone Remote).

IP Configuration

When you select this option, the **Monitor IP Configuration** screen appears, as shown in [Figure 2-55](#). In this screen, you can configure the PRM-4220 Ethernet port.



Note: This network setup applies only to the network connection for the PRM-4220, and not its dedicated Ethernet connection to the Remote.

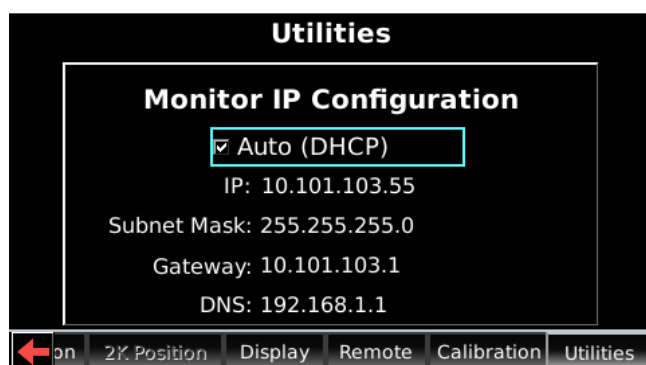


Figure 2-55 System/Utilities/Monitor IP Configuration Screen

Select **Auto (DHCP)**, or enter a fixed **IP** address, along with the **Subnet Mask**, **Gateway**, and **DNS**, and then press **ENTER**.



Caution: Be sure not to use an IP address within the range of 192.168.0.0 to 192.168.0.255.

Load Settings

You can load PRM-4220 system settings that are stored on a USB device. To load settings:

1. Select **System > Utilities > Load Settings**.

The **Load Settings** screen appears, as shown in [Figure 2-56](#).

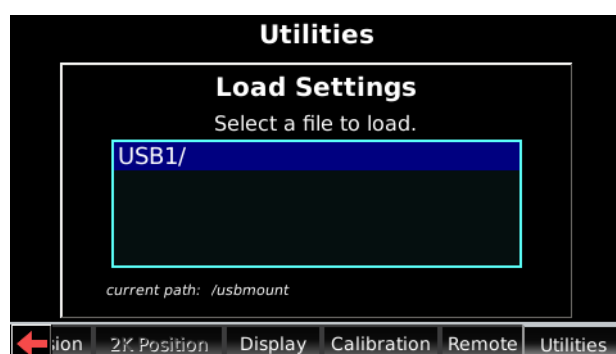


Figure 2-56 System/Utilities/Load Settings

2. Press **ENTER** to display the files on the USB device, use the arrow keys to select the settings file (see [Figure 2-57](#)), then press **ENTER** again to load the settings. Settings files have a .prm file extension.

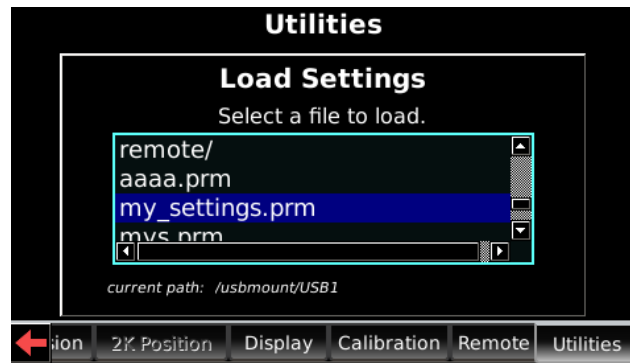


Figure 2-57 System/Utilities/Load Settings/Select a File to Load

Save Settings

You can save your current system settings on a USB device, which you can use as a backup or load onto another PRM-4220 (see [Load Settings](#)). Following is a description of this procedure.

1. Insert a USB device into one of the Remote USB ports.
2. Select **System > Utilities > Save Settings**.

The **Save Settings** screen appears, as shown in [Figure 2-58](#).

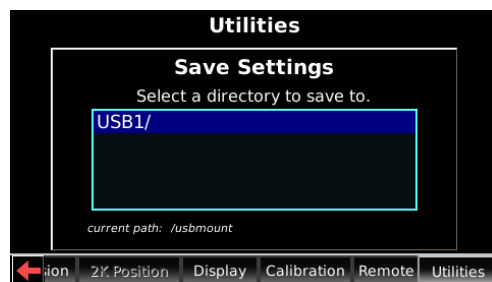


Figure 2-58 System/Utilities/Save Settings

3. Press **ENTER** to display the files on the USB device, use the arrow keys to select the directory where you want to save the settings (see [Figure 2-59](#)), then press **ENTER** again.

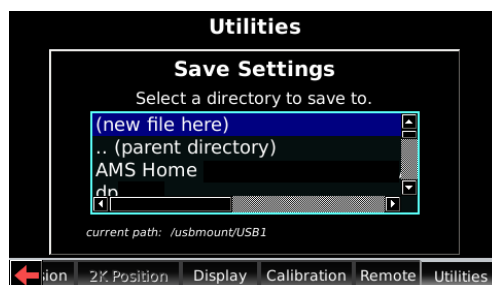


Figure 2-59 System/Utilities/Save Settings/Select a Directory

The **Save Settings** keypad appears, where you can name your settings, as shown in [Figure 2-60](#).

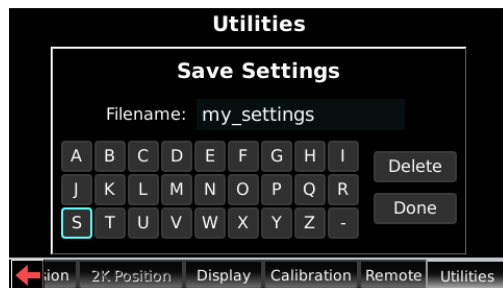


Figure 2-60 Save Settings Keypad

4. Use the Remote arrow keys and **ENTER** key to name your settings, select **Done**, and then press **ENTER** again to save the settings on the USB device. Settings files have a .prm file extension.

Load LUTs

You can load 3D LUTs and 1D LUTs on the PRM-4220. Following is a description of each of these procedures.

Loading a 3D LUT

The PRM-4220 supports Dolby .dd3, cineSpace, and Nucoda 3D LUTs.

To load a 3D LUT:

1. Insert a USB device (containing the desired 3D LUT) into one of the Remote USB ports.
2. Select **System > Utilities > Load LUTs**.

The **Load LUT** screen appears, as shown in [Figure 2-61](#).

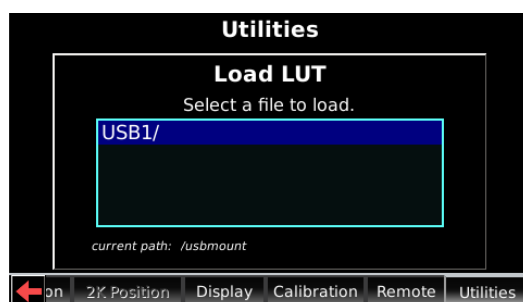


Figure 2-61 System/Utilities/Load LUT Screen

3. Press **ENTER** to display the files on the USB device, then use the arrow keys to select the desired 3D LUT, as shown in [Figure 2-62](#).
3D LUTs have a .dd3 or .csm file extension.

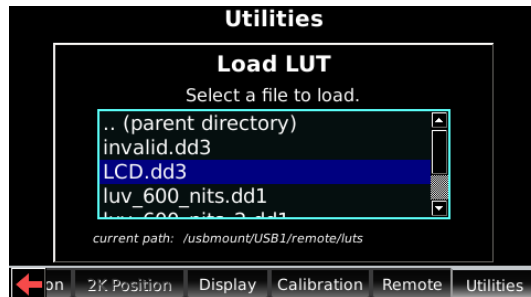


Figure 2-62 Select a File to Load Screen

4. Press **ENTER**.

The **Select where to load** screen appears, as shown in [Figure 2-63](#).

In this screen, you can load the desired 3D LUT into the **Custom 1** or **Custom 2** emulation mode.

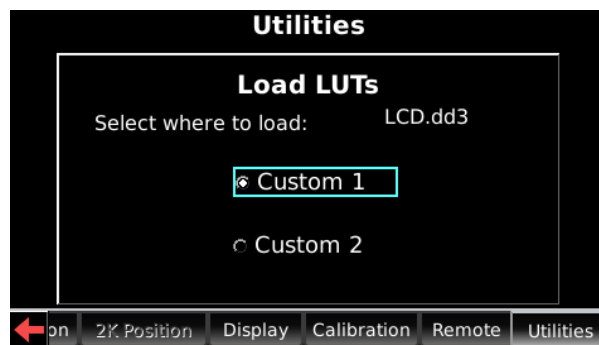


Figure 2-63 Select Where to Load Screen

5. Use the up/down arrow keys to load the 3D LUT into **Custom 1** or **Custom 2**, then press **ENTER**.

A confirmation prompt appears, as shown in [Figure 2-64](#).

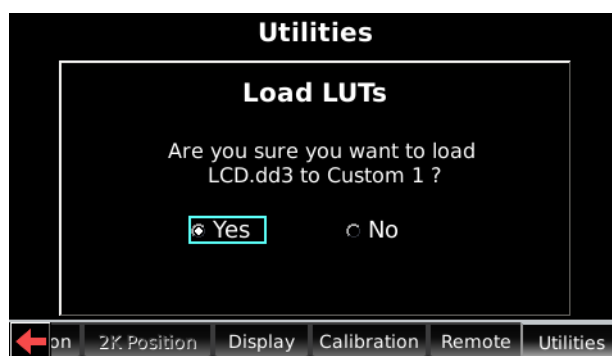


Figure 2-64 Load LUTs Confirmation Screen

6. Use the arrow keys to select **Yes**, then press **ENTER**.

The system loads the selected 3D LUT.

You can now activate the loaded 3D LUT by selecting the **Custom 1** key or **Custom 2** key on the Remote.

Loading a 1D LUT

The PRM-4220 uses .dd1 1D LUT files. The .dd1 LUT format is a custom high-resolution binary format created by Dolby Laboratories. For information on obtaining and creating 1D LUTs, contact Dolby Laboratories.

The system also supports industry standard .csv Nucoda format 1D LUTs.

To load a 1D LUT:

1. Insert a USB device (containing the desired 1D LUT) into one of the Remote USB ports.
2. Select **System > Utilities > Load LUTs**.

The **Load LUT** screen appears, as shown in [Figure 2-65](#).

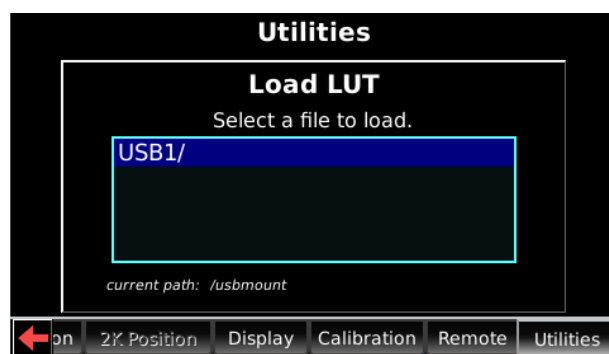


Figure 2-65 System/Utilities/Load LUT Screen

3. Press **ENTER** to display the files on the USB device, then use the arrow keys to select the desired 1D LUT, as shown in [Figure 2-66](#).
1D LUTs have a .dd1 or .csv file extension.

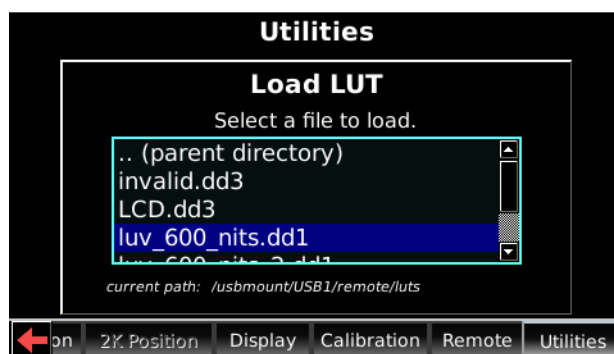


Figure 2-66 Select a File to Load Screen

4. Press **ENTER**.

The **Select where to load** screen appears, as shown in [Figure 2-67](#).

In this screen, you can load the desired 1D LUT into **LUT A**, **LUT B**, **LUT C**, or **LUT D**, which are accessible in the **Gamma/LUTs** screen (described previously in [Section 2.4.3](#)).

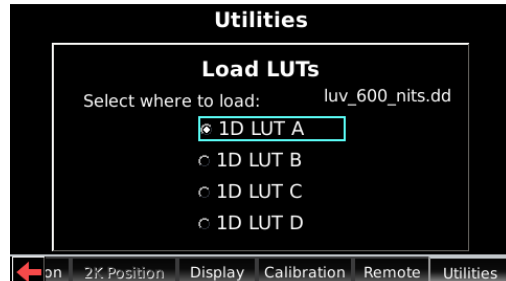


Figure 2-67 Select Where to Load Screen

5. Use the up/down arrow keys to load the 1D LUT into the desired location, then press **ENTER**.

A confirmation prompt appears, as shown in [Figure 2-68](#).

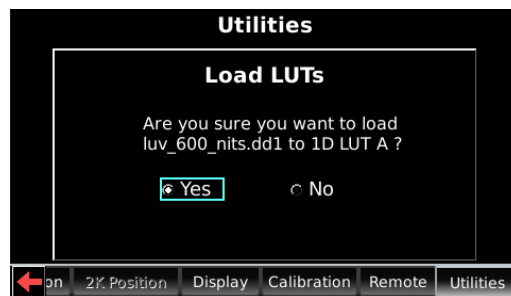


Figure 2-68 Load LUTs Confirmation Screen

6. Use the arrow keys to select **Yes**, then press **ENTER**.

The system loads the selected 1D LUT.

You can now activate the loaded 1D LUT by selecting it in the **Gamma/LUTs** screen. (See [Figure 2-69](#).)

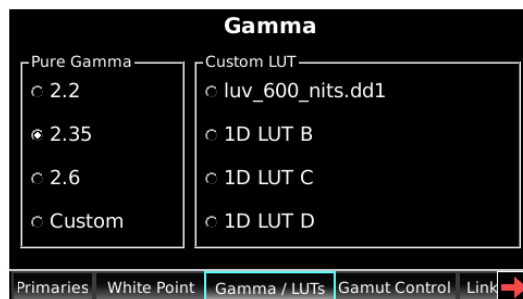


Figure 2-69 Gamma/LUTs Screen Displays Loaded 1D LUT

Lock/Unlock Monitor

To lock the monitor:

1. Select **System > Utilities > Lock/Unlock Monitor**.
2. Enter a four-digit code in the displayed data entry field using the Remote numerical keys, then press **ENTER** (see [Figure 2-68](#)).
3. To unlock the monitor, follow the previous steps and enter the same code.

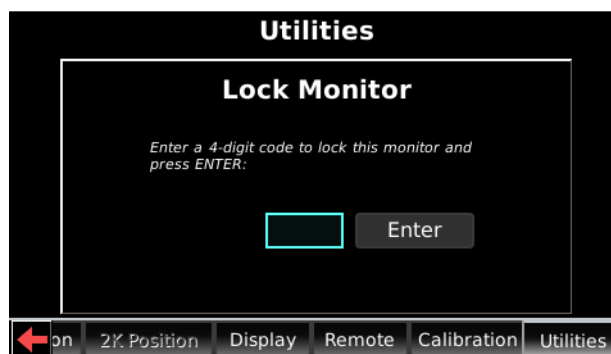


Figure 2-70 Lock Monitor Screen

2.4.15 System Menus

[Table 2-5](#) lists all of the system parameter screens and their displayed menu options.

Table 2-5 System Parameters

System Screen	Parameters
Primaries	Rec. 709, P3, SMPTE C, EBU, Custom
White Point	D54, D60, D65, D93, D-cinema, Custom
Gamma/LUTs	Pure Gamma (2.2, 2.4, 2.6, Custom) Custom LUT (LUT A, LUT B, LUT C, LUT D)
HD-SDI Link Mode	HD-SDI Detection: Automatic, Manual HD-SDI Mode: Single, Dual
HD-SDI Link Format	YCbCr 4:2:2, 4:4:4 10-bit/12-bit RGB 4:4:4 10-bit/12-bit XYZ 4:4:4 10-bit/12-bit
Aspect/Scaling	Aspect Ratio (Native, 4:3, 16:9, 2.35:1, Auto) Scaling (Pixel to Pixel, Fullscreen, Integer, Overscan, Underscan)
Action/Title Safe Area Markers	Action (90% - RP 218, 93% - ST 2046, Custom) Title (80% - RP 218, 90% - ST 2046, Custom)
Marker Mask	Mask Mode (Action Title, Off) Opacity Adjustable horizontal slider
Frame Rate Conversion	Deinterlacing (Direct Deinterlace, Deinterlace) Force PsF
3:2 Pull-down	(On/Off)
2K Image (2K inputs only)	Scale to Fit Pixel to Pixel Adjustable horizontal slider

Table 2-5 System Parameters (continued)

System Screen	Parameters
On-Screen Display	Timecode (On, Off) H/V Display (On, Off) Marker Color (White, Lumamod)
4:3 Markers	On/Off Adjustable horizontal slider
Remote Settings	Normal, Dimmed (LED brightness, LCD brightness) Adjustable horizontal sliders
Calibration/Reset	Manual Color Calibration (screen) Factory Reset (dialog box)
Utilities	About Monitor (dialog box) System Status (dialog box) Software Upgrade (dialog box) IP Configuration (dialog box) Load Settings (dialog box) Save Settings Load LUTs (dialog box) Lock/Unlock Monitor (dialog box)



Note: The primaries and white point parameters are inaccessible when the input is XYZ or when an emulation mode or user-loaded 3D LUT custom mode is active. In such cases, these parameters are absolute.



Note: The gamma/LUTs parameter is inaccessible when an emulation mode or a user-loaded 3D LUT custom mode is active. In such cases, this parameter is absolute.

2.5 Saving and Loading Custom Presets

You can use the Remote numerical keys to save and load your current settings as custom presets. Ten presets are provided, one for each numerical key (0 through 9). Each preset saves the current state of all PRM-4220 parameters. In addition, when you save a preset, it stores information for an active LUT.



Note: You cannot save or load a preset while a data entry field is active.

1. To save a preset, press and hold the desired key for a minimum of three seconds, select **OK** at the prompt (see [Figure 2-71](#)), then press **ENTER**. Always make a note of the number you use for each preset.

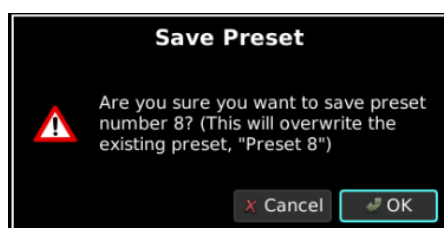


Figure 2-71 Save Preset Screen

The **Preset Name** screen appears, which displays a keypad, as shown in [Figure 2-72](#).



Figure 2-72 Preset Name Screen

2. Use the Remote arrow keys and **ENTER** key to name your preset on the displayed keypad, select **Done**, and then press **ENTER** again.
3. To load a preset, press the corresponding numerical key on the Remote for at least a half second, select **OK** at the prompt (see [Figure 2-73](#)), then press **ENTER**.

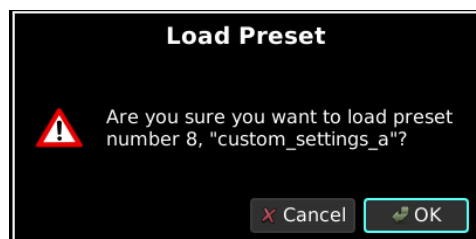


Figure 2-73 Load Preset Screen

When you load a preset, its numerical key and name appear in the **Status1** screen instead of the respective display mode (for example, for preset 1 [**P1:Preset 1ac**], as shown in [Figure 2-74](#)).

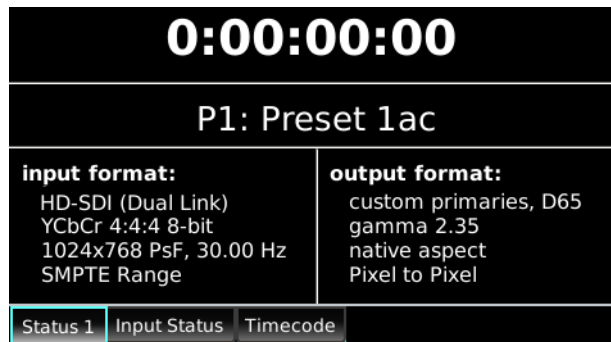


Figure 2-74 Preset Displayed in Status1 Screen

If you load a preset and then change any image settings, an asterisk appears next to the preset name in the **Status1** screen. This indicates that the currently loaded preset was modified.

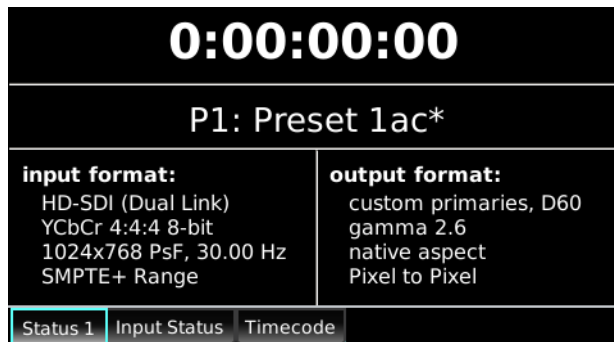


Figure 2-75 Modified Preset Displayed in Status1 Screen

Image settings are defined as any settings, excluding:

- R/G/B channels on/off
- Mono
- Action and title safe markers
- B/C lock
- Cursor controls
- Lock/unlock monitor
- Timecode

To remove any modifications to a loaded preset, you can either reload the respective preset or reset the modified parameters to their original values. In either case, the preset will appear in the **Status1** screen without an asterisk. To exit the preset mode and return to the display mode, press and hold a status display key (for example, **REF MODE**). In such a case, the name of the respective display mode reappears, but the system retains the currently loaded preset parameters.

PRM-4220 Maintenance

This chapter describes some basic maintenance procedures for the Dolby® PRM-4220.

A.1 Replacing the Filter

Your PRM-4220 has an air filter installed that you need to check periodically. When the filter contains an excessive amount of dust, you need to replace it. We recommend that you replace the filter at least every 90 days. Depending on your environment, you may need to replace the filter more often. By checking the filter regularly, you can determine the replacement cycle that works best for you. Failure to replace the filter at the recommended interval could affect the operation of the monitor.

A.1.1 Required Tools and Parts

You will need the following:

- Phillips screwdriver
- Replacement air filter (extra filter included with monitor)

You can purchase Dolby PRM-4220 replacement air filters (Dolby Part Number 6504850) through your authorized Dolby PRM-4220 dealer.

For customers located in Europe, the Middle East, and Africa:

Phone: +31-20-651-1800

Email: SSCNL@dolby.com

For customers located in the Americas, Asia, and the Pacific region:

Toll-free phone: +1-800-26-DOLBY (+1-800-263-6529)

Email: SalesAdmin@dolby.com

For technical support related questions:

- Send an email to videosupport@dolby.com. Call Dolby Customer Service at +1-415-645-4903.
- Contact your local Dolby representative.

A.1.2 Filter Replacement Instructions

To replace the PRM-4220 filter (refer to [Figure A-1](#)):

1. Use a Phillips screwdriver to remove the four retaining screws at the top and bottom of the filter door, which is located on the PRM-4220 rear panel.
2. Using both hands, lean the filter door out on a slight angle, then remove the filter door, remove the filter, and replace it with the new filter.
3. Using both hands, replace the filter door, and then insert and tighten the four retaining screws.

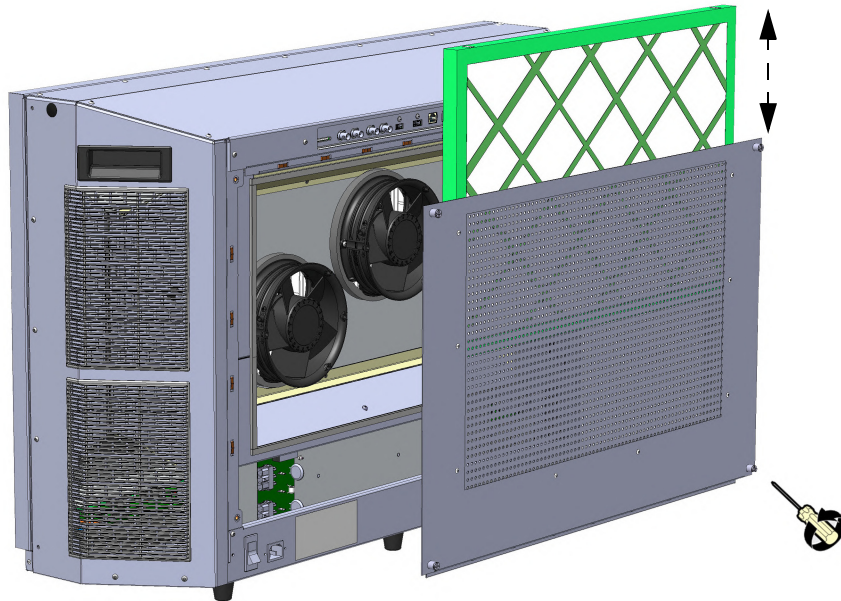


Figure A-1 Replace PRM-4220 Filter

A.2 Cleaning the Monitor Screen

To clean the PRM-4220 screen, we recommend an LCD-compliant cleaning solution and a soft cloth.

Dolby PRM-4220 Specifications

HD-SDI and Dual-Link HD-SDI Video Support

Single-link HD-SDI bit depths and color schemes:

1.5G 10 bits per component YCbCr 4:2:2

Dual-link HD-SDI bit depths and color schemes:

10 bits per component 4:4:4 RGB, 4:4:4:4, YCbCr, and 4:4:4 XYZ

12 bits per component 4:4:4 RGB, 4:4:4 YCbCr, 4:2:2 YCbCr, and 4:4:4 XYZ

1,080-line formats supported in both $1,920 \times 1,080$ and $2,048 \times 1,080$

HD-SDI and dual-link HD-SDI video formats:

720/60p

720/59.94p

720/50p

1,080/60i

1,080/59.94i

1,080/50i

1,080/30p

1,080/29.97p

1,080/25p

1,080/24p

1,080/23.98p

1,080/30psf

1,080/29.97psf

1,080/25psf

1,080/24psf

1,080/23.98psf

High Frame Rate HD-SDI Video Support

High frame rate HD-SDI (single-link and dual-link) bit depths and color schemes:

Dual-link or single-link 3GA/3GB HD-SDI

10-bits per component YCbCr 4:2:2

High frame rate HD-SDI/dual-link HD-SDI/single-link 3GA/3GB HD-SDI video formats:

1080/60p

1080/59.94p

1080/50p

1080/48p

SD-SDI Video Support

Single-link SD-SDI bit depths and color schemes:
10 bits per component YCbCr 4:2:2

SD-SDI video formats:
480/59.94i (SD SDI NTSC)
575/50i (SD SDI PAL)

HDMI and DisplayPort Video Support

HDMI™ and DisplayPort bit depths and color schemes:
8/10/12** bits per component, YCbCr 4:2:2*, YCbCr 4:4:4, RGB 4:4:4
*YCbCr 4:2:2 and interlaced modes not supported by DisplayPort.
**1080/60p in 12 bits per component not supported by HDMI.

HDMI and DisplayPort video formats:
1080/60p**
1080/60i*
720/60p
480/59.94p
480/60p
1080/50i*
720/50p
576/50p

Digital Video Interfaces

SMPTE 295M, SMPTE 294M, SMPTE 292M, SMPTE372M, SMPTE424M, SMPTE425M

Video Scanning Formats

ITU-R BT.601, SMPTE 293M, ITU-R BT.1358,
SMPTE 274M, SMPTE RP211

Audio/Video Sync Output

75Ω BNC connector, active high TTL-level output

Monitor LCD Display

Size: 1,067 mm diagonal (42 inches diagonal)
Resolution: 1,920 × 1,080 pixels
Refresh rate: 120 Hz
Viewing angle: 90° horizontal

Display Modes

Reference mode (Ref Mode)
Dynamic mode
Emulation modes (LCD, PDP)
User-loaded 3D LUT modes (Custom 1, Custom 2)

Maximum Luminance

Ref Mode: 120 cd/m²
Dynamic Mode: 600 cd/m²

Primaries/Gamut

Rec. 709, SMPTE C, EBU, P3, Custom

White Point

D54, D60, D65, D93, D-cinema, Custom

Gamma

2.2, 2.4, 2.6, custom

Power Consumption

1,000 volt-amperes maximum (15 amp minimum breaker size)

Line Voltage Compatibility

85–260 VAC, 50–60 Hz

Operating Temperature

0°C to 35°C

Optimum 25°C, $\pm 5^{\circ}\text{C}$

Storage Temperature

–20°C to 70°C

Humidity

30% to 90% relative humidity, noncondensing

Remote Controller Dimensions

2-U rackmount or tabletop use

Weight

107 pounds (48.5 kilograms)

Monitor Dimensions

[Figure B-1](#) (on the following page) shows the PRM-4220 dimensions in millimeters.

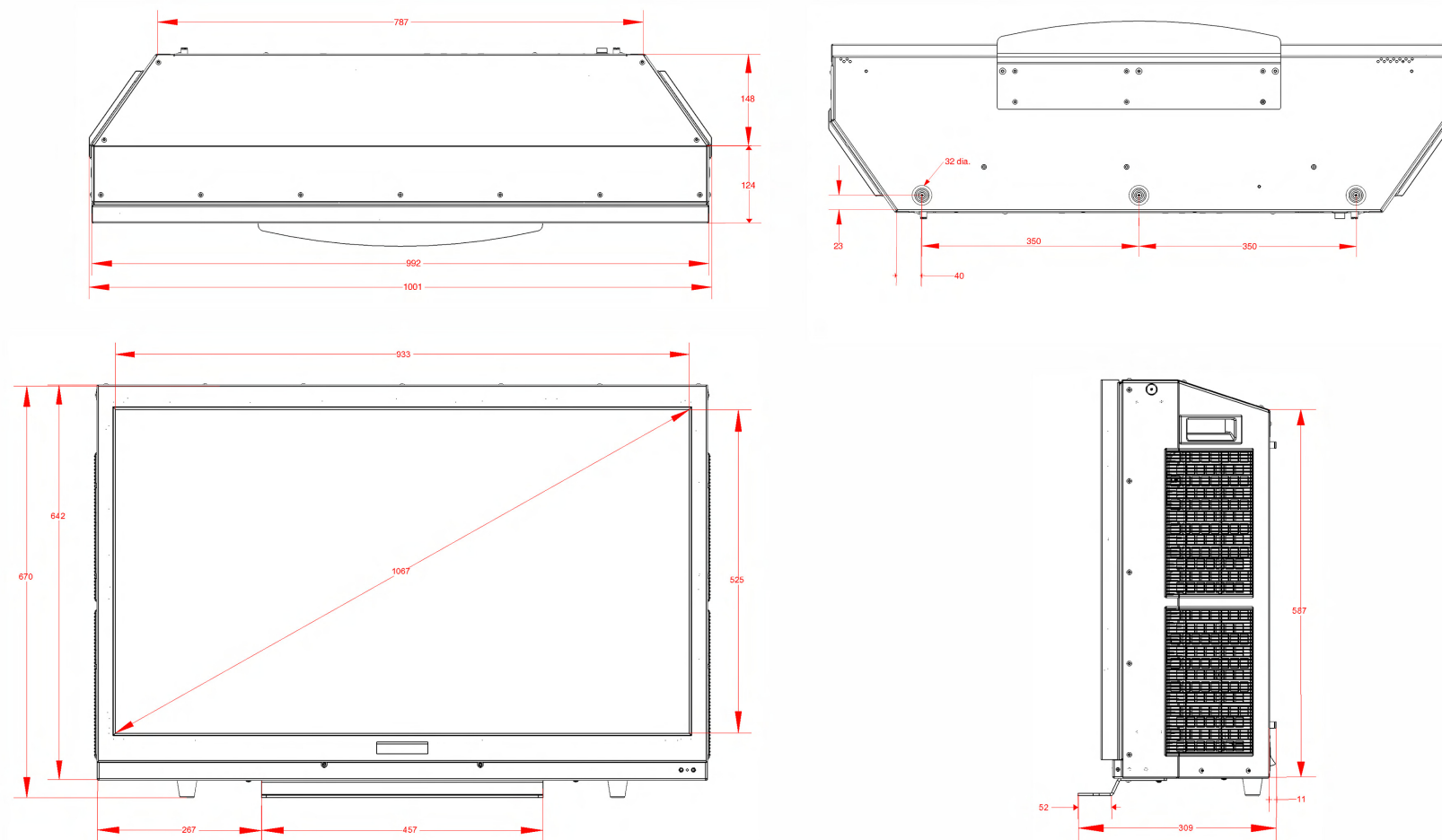


Figure B-1 PRM-4220 Dimensions (Millimeters)

Frequently Asked Questions

This appendix provides answers to frequently asked questions regarding the Dolby® Professional Reference Monitor (PRM-4220).

My CRT has a bias control. Why is there no bias control on the PRM-4220?

CRTs are analog devices, which require both gain and bias controls, as they are sensitive to small voltage offsets in the signal path. Typically, you adjust the gain control first to set the white point, and then set the bias control to adjust the black point. You then have to adjust gain a second time, as the first bias setting affects the first gain setting. Then you adjust the bias setting a second time. If performed correctly, the two gain and bias adjustments result in accurate white and black points.

The PRM-4220 utilizes Dolby technologies that deliver extremely accurate, linear, and stable gray-scale response after setting the white point using the gain controls. In addition, the PRM-4220 provides white point and maximum luminance controls, which enable users to fine-tune the monitor with a very high degree of precision.

As a result, users can set up the Dolby PRM-4220 to closely match the response of a reference CRT monitor.

Can I display two images on the screen at the same time (split screen)?

Currently, this is not possible.

The latency between input and output is unacceptable for switching use.

All digital devices have a delay from input to output. To achieve reference-level video quality, the PRM-4220 incurs a slight additional delay. Currently, eliminating this latency is not possible.

Note that the PRM-4220 has a unique audio sync pulse output. When you use this output together with a compatible audio delay line, this results in a higher degree of audio/video synchronization than any other monitor at all frame rates.

How do I log running hours?

CRT users need to log the number of hours the monitor is operational, so they can manage tube replacement (typically every 12–18 months). The PRM-4220 LEDs are designed for more than 50,000 hours of operation, so there is no need to log use hours as you would a traditional CRT vacuum tube.

I locked the monitor in the Utilities screen using a four-digit code, but I forgot the code and cannot unlock the monitor.

Reboot the PRM-4220 and the Remote. The lock mode is not persistent, but is removed when you reboot the PRM-4220.

Using the Remote, I cannot select the SDI B Link input, but I connected an HD-SDI input to the SDI B input port.

Link B is active only when link A also has a valid input. Use link A for all single-link input operations.

When I start up the PRM-4220, the Remote freezes at the “Searching for Monitor” screen.

Be sure the Remote Ethernet cable is connected firmly to both the Remote and the PRM-4220 **REMOTE** port.

Be sure the Remote and the PRM-4220 are running the same software version. If necessary, upgrade the software on the monitor and/or the Remote (see [Software Upgrade](#)).

How do I acquire the latest version of the PRM-4220 software?

You can obtain the latest software upgrade (.dlb file) from www.dolbycustomer.com. You will need to register and establish your user credentials.

How do I clean the PRM-4220 LCD screen?

We recommend an LCD-compliant cleaning solution and a soft cloth.

Does the PRM-4220 have an air filter? if it does, how often do I need to replace it and where can I purchase a replacement air filter?

See [Appendix A](#) in this manual.

Navigating the System

Figure D-1 provides a PRM-4220 navigation tree.

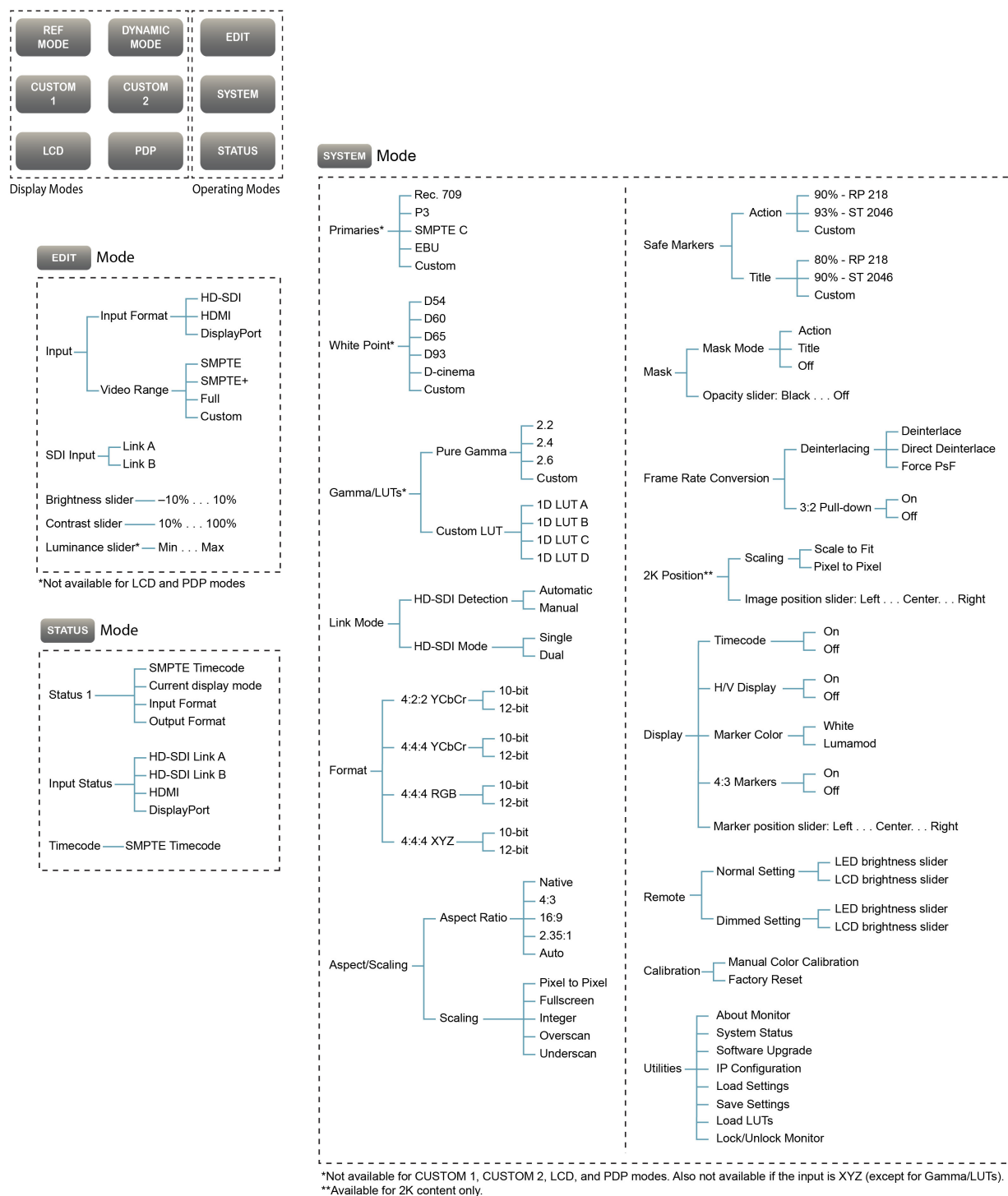


Figure D-1 PRM-4220 Navigation Tree

PRM-4220 Patents and Open-Source Software

This appendix lists all of the Dolby® PRM-4220 patents and the open-source software attribution.

E.1 PRM-4220 Patents

Following is a list of the United States patents.

7,413,307
7,419,267
7,377,652
7,581,837
7,172,297
6,891,672
7,731,367
7,801,426
7,753,530
7,370,979
7,800,822
7,777,945
7,403,332
7,551,341

Worldwide patents are granted and pending.

E.2 PRM-4220 Open-Source Software Attribution

The following table lists the open-source software used in the production of the PRM-4220.

Table E-1 PRM-4220 Open Source Software

Package	Home Page	License
apr apr-utils	http://apr.apache.org/	http://www.apache.org/licenses/LICENSE-2.0
avahi	http://avahi.org/	http://www.gnu.org/licenses/lgpl.html
bash	http://www.gnu.org/software/bash/	http://www.gnu.org/licenses/gpl.html
boost	http://www.boost.org	http://www.boost.org/users/license.html
busybox	http://www.busybox.net/	http://www.gnu.org/licenses/old-licenses/gpl-2.0.html
curl	http://curl.haxx.se/	http://curl.haxx.se/docs/copyright.html
dbus	http://www.freedesktop.org/wiki/Software/dbus/	http://dbus.freedesktop.org/doc/COPYING
dhcp	ftp://ftp.isc.org/isc/dhcp/dhcp-3.0-history/	http://opensource.org/licenses/ISC
diffutils	http://www.gnu.org/software/diffutils/	http://www.gnu.org/licenses/gpl.html
dosfstools	http://daniel-baumann.ch/software/dosfstools/	http://www.gnu.org/licenses/gpl.html
dropbear	https://matt.ucc.asn.au/dropbear/dropbear.html	http://opensource.org/licenses/MIT
e2fsprogs	http://e2fsprogs.sourceforge.net/	http://www.gnu.org/licenses/gpl.html
eeprog	http://www.codesink.org/eeprog.html	http://www.gnu.org/licenses/old-licenses/gpl-2.0.html
expat	http://sourceforge.net/projects/expat/	http://www.jclark.com/xml/copying.txt
gawk	http://www.gnu.org/software/gawk/	http://www.gnu.org/licenses/gpl.html
gdb	https://www.gnu.org/software/gdb/	http://www.gnu.org/licenses/gpl.html
glib	http://library.gnome.org/devel/glib/	http://www.gnu.org/licenses/lgpl.html
json-c	https://github.com/json-c/json-c/wiki	http://opensource.org/licenses/MIT
lcm	http://code.google.com/p/lcm/	http://www.gnu.org/licenses/lgpl.html
less	http://www.gnu.org/software/less/	http://www.gnu.org/licenses/lgpl.html
libconfig	http://www.hyperrealm.com/libconfig/	http://www.gnu.org/licenses/lgpl.html
libdaemon	http://0pointer.de/lennart/projects/libdaemon/	http://www.gnu.org/licenses/lgpl.html
libjpeg	http://libjpeg.sourceforge.net/	http://libjpeg.cvs.sourceforge.net/viewvc/libjpeg/libjpeg/README?revision=1.1
liboil	http://liboil.freedesktop.org/wiki/	http://opensource.org/licenses/BSD-2-Clause

Table E-1 PRM-4220 Open Source Software (continued)

Package	Home Page	License
tcpdump libpcap	http://www.tcpdump.org/	http://opensource.org/licenses/BSD-3-Clause
libtiff	http://www.libtiff.org/	http://www.libtiff.org/misc.html
libusb	http://www.libusb.org/	http://www.gnu.org/licenses/old-licenses/gpl-2.1.html
linux	https://www.kernel.org/	https://www.kernel.org/pub/linux/kernel/COPYING
lzo	http://www.oberhumer.com/opensource/lzo/	http://www.oberhumer.com/opensource/gpl.html
module-init-tools	https://modules.wiki.kernel.org/index.php/Main_Page	http://www.gnu.org/licenses/old-licenses/gpl-2.0.html
mtdev	http://www.linux-mtd.infradead.org/	http://www.gnu.org/licenses/gpl.html
ncurses	http://www.gnu.org/software/ncurses/	http://invisible-island.net/ncurses/ncurses-license.html
ntplib	http://doolittle.icarus.com/ntplib/	http://www.gnu.org/licenses/old-licenses/gpl-2.0.html
popt		http://opensource.org/licenses/MIT
procps	http://procps.sourceforge.net/	http://www.gnu.org/licenses/old-licenses/gpl-2.0.html
psmisc	http://psmisc.sourceforge.net/	http://www.gnu.org/licenses/gpl.html
python	http://www.python.org/	http://docs.python.org/2/license.html
qt-embedded	http://qt.digia.com	http://www.gnu.org/licenses/lgpl-2.1.html
redboot	https://sourceware.org/redboot/	http://ecos.sourceware.org/license-overview.html
schedutils	http://sourceforge.net/projects/schedutils/	http://opensource.org/licenses/BSD-2-Clause
sed	http://www.gnu.org/software/sed/	http://www.gnu.org/licenses/gpl.html
strace	http://sourceforge.net/projects/strace/	http://sourceforge.net/p/strace/code/ci/master/tree/COPYING
usbutils	https://www.kernel.org/pub/linux/utils/usb/usbutils/	http://www.gnu.org/licenses/old-licenses/gpl-2.0.html
vsftpd	https://security.appspot.com/vsftpd.html	http://www.gnu.org/licenses/old-licenses/gpl-2.0.html
xmlrpc-c	http://xmlrpc-c.sourceforge.net	http://sourceforge.net/p/xmlrpc-c/code/HEAD/tree/trunk/doc/COPYING
zlib	http://zlib.net	http://zlib.net/zlib_license.html

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